APRIL 1955

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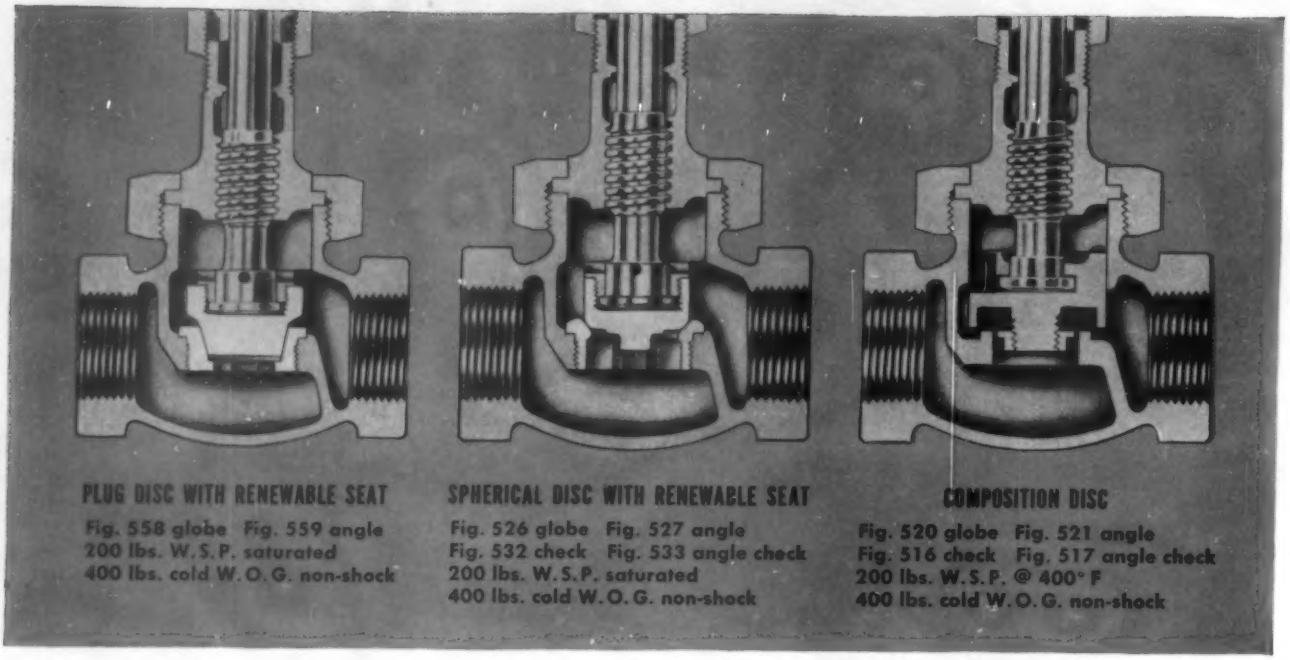

PLUG DISC WITH RENEWABLE SEAT
Fig. 558 globe Fig. 559 angle
200 lbs. W.S.P. saturated
400 lbs. cold W.O.G. non-shock

SPHERICAL DISC WITH RENEWABLE SEAT
Fig. 526 globe Fig. 527 angle
Fig. 532 check Fig. 533 angle check
200 lbs. W.S.P. saturated
400 lbs. cold W.O.G. non-shock

COMPOSITION DISC
Fig. 520 globe Fig. 521 angle
Fig. 516 check Fig. 517 angle check
200 lbs. W.S.P. @ 400° F
400 lbs. cold W.O.G. non-shock

Choose the OIC disc-seat combination of greatest reliability

The modern OIC "500 Line" provides a choice of 3 bronze globe valve designs to meet specific sets of operating conditions.

You can rely on all three. But you will improve over-all globe valve performance by selecting the design which especially fits your particular operating requirements.

Base your selection on these facts

Plug disc with renewable seat—Use where throttling is required on services up to 550°F. Tapered disc and seat are stainless steel, hardened to 500 Brinell. They resist erosive and abrasive wear resulting from throttling . . . even crush foreign particles to effect tight closure without damage to seating surfaces. Seat and disc may be reground or replaced.

Spherical disc with renewable seat—Use in general wide-open and closed service, up to 550°F, where frequent cycles of operation will be required. Seat and disc are copper-nickel alloy, resistant to corrosion and galling. Disc and seat mate by line contact assuring positive tight closure on any fluids. Both seat and disc may be reground or replaced.

Composition disc—Normally furnished with 8E disc—suitable for steam, hot water, oil and gas—designed for use in wide open or closed position. This relatively soft disc material permits disc to effect tight closure in spite of small scratches or particles on the seat. This valve may be used for a number of services by fitting it with discs suitable for the fluids to be handled. Use of slip-on type disc-holders simplifies disc replacement.

Stems on all "500 Line" valves are machined from special OIC 40-alloy which will not gall or seize. The complete "500 Line" includes bronze globe, angle and check valves, with many parts interchangeable.

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Write for Form No. 1001 which describes the "500 Line" more fully.

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THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

For more data circle 501 on Post Card

LOWEST COST PER POUND OF STEAM

STARTS WITH FEATURES LIKE THESE

OPERATING ENGINEER:
"Ease of maintenance at less cost in time and materials — more dependable year-round operation."
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"All-welded construction — approved electronic operating and safety devices . . . meet ASME and Underwriters Laboratories codes."
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"Boilers shipped ready to install — can be in operation in as little as 24 hours after delivery."
BOILER INSPECTION ENGINEER:
"A large low-furnace design provides greater safety."

"It's NEW — Get The Facts On The CB Boiler — Write Today"

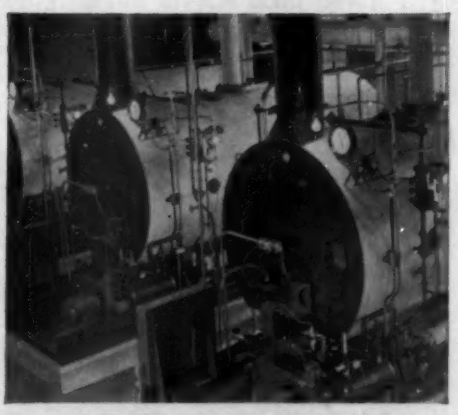
that's why you profit most from Cleaver-Brooks self-contained boilers

• Top to bottom, inside and out, you get more money-saving features when you specify or buy Cleaver-Brooks self-contained boilers. You make an *investment in quality* that pays off in lowest net cost per pound of steam for processing or heating.

YOU BENEFIT from more than 20 years of experience, working closely with men who have made it their business to be *right* about boilers. You profit from complete coordination throughout planning, installing, supervising and final operation.

YOU BENEFIT from self-contained design and original four-pass construction. These Cleaver-Brooks engineered "firsts," plus forced draft, 5 sq. ft. of heating surface per boiler hp, and exclusive burners, all contribute to highest heat transfer. Guaranteed 80% thermal efficiency when firing with oil is the direct result!

Whether you're planning a new steam plant or modernizing, make certain you get the complete Cleaver-Brooks story before you buy. See your Cleaver-Brooks representative, or write for catalog AD-100. Cleaver-Brooks Company, Dept. D-311 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable Address CLEBRO — Milwaukee — All Codes.*



One typical owner can count on yearly savings ($15,000 fuel and $10,000 labor) from this battery of three 150 hp Cleaver-Brooks self-contained boilers.

•

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

•

Cleaver Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

BOILERS . . . STEAM OR HOT WATER . . . FOR HEATING OR PROCESSING, IN SIZES FROM 15 TO 500 hp, 15 to 250 PSI.

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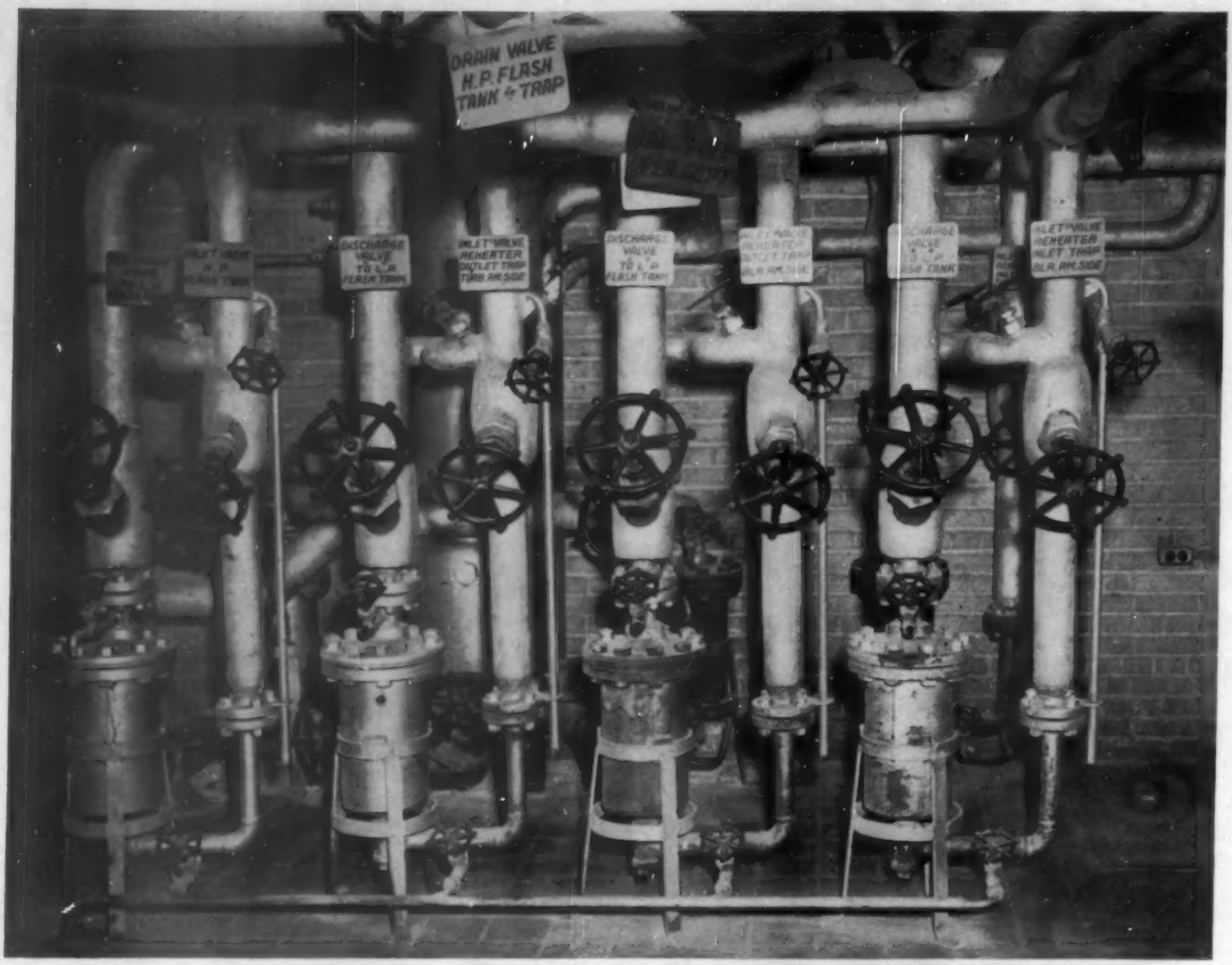

"Panel" of Eleven says Traps are Best for draining Superheated Steam Lines

. . . AND THESE PLANTS AGREE

Typical Armstrong high pressure trap users:

Consumers Power Company—
Comstock, Erie, Essexville, Muskegon, Zeiwaukee, Michigan

Ohio Power Company, Philo, Ohio

Kansas City Power & Light—
Kansas City, Mo.

Georgia Power Company—
Yates, Macon, McManus, Georgia

United Illuminating Company—
New Haven, Conn.

Philadelphia Gas & Electric—
Philadelphia, Pa.

San Diego Gas & Electric—
San Diego, Calif.

Wisconsin Electric Power Company,
Milwaukee, Wisconsin

Northern States Power Company—
St. Paul, Granite Falls, Black Dog, Minn.

Cincinnati Gas & Electric Company,
Cincinnati, Ohio

One of the readers of a power plant publication recently asked, "which is the best device for removing condensate from lines carrying superheated steam . . ."

Eleven readers answerd this published question. *All* agreed, from experience, that steam traps are best.

Traps are automatic. Traps prevent steam loss. Traps take care of boiler carryover. Traps are available with sufficient capacity to take care of any condensate load. Traps don't "forget" to drain the lines.

Since 1929, Armstrong inverted bucket forged steel steam traps have kept pace with the trend to higher steam pressures. Today, they are widely recognized as essential safety devices in leading power plants throughout the world operating at pressures up to 2400 psig.

For safe, dependable drainage of superheated steam lines, get the facts about Armstrong traps. Call your local Armstrong Representative or write Armstrong Machine Works, 810 Maple St., Three Rivers, Michigan.

ASK FOR REPRINT—

"Should We Trap Superheated Steam Lines"—tells the experience of trap users . . . answers your questions on high pressure trapping. Ask for Catalog J, too . . . complete data on Armstrong forged steel traps. Free on request—no obligation.

Application Engineered

ARMSTRONG STEAM TRAPS

For more data circle 503 on Post Card

ENGINEERS' PREVIEW

OF COURSE, you and we know that sinusoidal has nothing to do with a running nose, and that optimalization doesn't mean looking on the bright side of everything.

But many a businessman stands in awe of the engineering profession's accomplishments in today's atomic age, yet is baffled by and a little impatient with the growth of engineeringese in our everyday language. Words like sinusoidal, reproducibility, feedback, optimalization are bandied about these days by engineering-trained executives as though they were common terms.

One firm, perhaps prompted by its corporate conscience, since its own automation engineers have contributed heavily to this polytechnical polyglot, decided to try and clear up some of the confusion. Surveying the technical terms most broadly used, the Philadelphia-based Industrial Division of Minneapolis-Honeywell has packaged them in a modest booklet, called an Automation Dictionary complete with amazingly clear laymanlike definitions. It covers some 87 words and phrases.

For example: the definition of measuring means. By most standard engineering definitions, it takes some 30 words to explain. The M-H boys dispose of it in seven, explaining it's "whatever is used to measure a condition." What could be fairer?

Lest their engineering brethren cry treason, the designers of the simplified booklet carefully point out that it was primarily designed "for those whose knowledge of automatic control is largely limited to setting the thermostat on the living room wall."

GRANT OF $50,000 from the General Electric Educational and Charitable Fund to aid in a fundamental revision of undergraduate electrical engineering education at the Massachusetts Institute of Technology has been announced by Professor C. Richard Soderberg, Dean of Engineering. The grant will aid Dr. Gordon S. Brown, head of the Department of Electrical Engineering, to develop stimulating new instructional methods, materials, and techniques based on new concepts of teaching electrical engineering.

• • •

LIGHTNING is not only fast but some of it is comparatively "cold" and does insignificant damage, compared with "hot" high amperage strokes, A. M. Opsahl, of Westinghouse Electric Corp., told the Winter Meeting of the AIEE.

"When a lightning stroke terminates at earth," he said, "a stroke current flows which is almost entirely independent of any influence by the object struck. If the object struck does not have sufficient conductivity, damage can result as in the familiar cases of trees and chimneys. The lightning rod system provides a lightning terminal and an adequate path to ground to protect such nonconductors from damage."

See: Have You Checked Your Plant's Lightning Protection?, POWER ENGINEERING, October 1954.

• • •

THREE MEN have been elevated to the rank of Fellow of ASME. They are Montrose K. Drewry, chief engineer of power plants, Wisconsin Electric Power Co., Milwaukee, Wis.; Harry R. Kessler, manager of the New York office of the Republic Flow Meters Co.; and James M. Landis, chief power engineer, Bechtel Corp., San Francisco, Calif. To be qualified as a nominee to the rank of Fellow, one must be an engineer with acknowledged engineering attainments, 25

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Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, in other countries $12 per year; single copies $1.00.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Micro film edition: Request prices, from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948.

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Change of Address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Your request must reach us by the 15th of the month to make the necessary change effective with following month's issue.

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

Roller-Smith

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NEW...

UNI-BUS BUSWAY

A New Concept in busway systems that obsoletes all other methods of carrying current.

- Low Voltage Drop in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- High Short Circuit Strength in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- ***ONE FLEXIBLE FITTING*** makes elbows, offsets —simplifies engineering and eliminates costly delays.
- ***COMPLETE SAFETY*** because live bus bars at plug outlets and live connections in plugs are eliminated.

And All at Lower Cost!

Roller-Smith
CORPORATION
ELECTRICAL SWITCHGEAR
BETHLEHEM, PENNSYLVANIA

ECONOMY

New slip-on hanger and lighter weight busway mean less installation time. Feeder system often costs less than conduit and wire, yet is 100% reusable.

FLEXIBILITY

Flexible connector eliminates all special fittings so that a minimum number of components meet all job requirements. Plug-in and feeder systems interchangeable.

SAFETY

Interlocked safety slide over plug outlet cannot be opened until covered by plug. Interlocked cover and visible contacts in plug are positive assurance of safety.

years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and a member of the Society for at least 13 years.

• • •

THIS YEAR, for the first time in more than a century, the number of steam locomotives in service on American railroads dropped below the 10,000 mark. Of the remaining steamers, 30 per cent were in serviceable storage as of August 1. Only one Class I railroad still operates exclusively with steam motive power. Several roads joined the ranks of the 100 per cent dieselized.

A new world speed record for vehicles on rails was set in 1954 by an electric locomotive hauling a three-car test train on the French National Railways. The train operated at a sustained speed of *150.9 miles per hour*.

These developments and others were summarized by T. F. Perkinson at the ASMEs' annual meeting in December.

• • •

FRANKLIN C. MACKRELL, a vice-president of Stone & Webster Engineering Corp., has been appointed district manager in charge of its Chicago office, following the retirement on December 31, 1954, of Louis H. G. Bouscaren who had held that post for 33 years and had served the Stone & Webster organization for more than 50 years.

• • •

IMPORTANCE to the nation of an adequate reserve of trained engineers, scientists and other professional personnel is almost self-evident. If this country is to keep pace with others in the rapid expansion in atomic energy, medicine, chemistry and other sciences, the programs offered by the nation's colleges and universities must be re-examined and evaluated in the light of future needs.

After three years of work, a 332-page study, which for the first time collates detailed information about the country's trained personnel in virtually every major profession, was recently completed. This study, made under a $240,000 grant from the Rockefeller Foundation, has been published by Harper & Brothers under the title of America's Resources of Specialized Talent.

"What's wrong? Didn't you ask me to thread this rod?"

The report, which will undoubtedly become a standard reference in its field, finds that the United States is not preparing enough men and women in the natural sciences, the health fields, teaching and engineering. One aspect of this was discussed in Russian Technology Is Very Good, POWER ENGINEERING, December 1954, page 65.

• • •

JAMES D. CUNNINGHAM, president of Republic Flow Meters Co., and Alex D. Bailey, retired Commonwealth Edison Co. vice-president, have been named co-chairmen of the 75th anniversary annual national meeting of ASME to be held November 13–18 in Chicago, at the Conrad Hilton Hotel. The Chicago section of the society will be host to the visitors.

• • •

AT THE RECENT Annual Meeting of the Coal Producers Committee for Smoke Abatement in Cincinnati, H. B. Lammers of the Committee called attention to the fact that, during the last year, more and more Chambers of Commerce have requested assistance from the Committee in solving air pollution problems in their respective cities. Where previously these organizations were inclined to take a negative attitude toward smoke abatement programs, they now, in many instances, actually initiate them, or at least decide to take the lead at the first agitation.

"This," Mr. Lammers said, "is of vital importance to the coal industry. First of all, we are now being 'invited' into the leading coal burning plants. Formerly when agitation was allowed to run its course and City Hall finally was compelled to act by the pressure of public opinion, the plant management usually looked on the whole procedure as something they had to endure because of a bunch of busybodies.

"Now much of that is changed. Through surveys made by the Coal Producers Committee for Smoke Abatement, the word finally has gotten around that smoke abatement is a paying proposition," Mr. Lammers continued. "It pays off not only in increased coal burning efficiency but also in improved public relations.

"Today the recommendations made by the Committee engineers to abate smoke and improve efficiency are followed completely or in part by more than 65 per cent of the plants visited in any city. In some cities this has run as high as 90 per cent.

"This means that these plants are now more satisfied with coal and that oil or gas will have less chance of success in talking conversion."

• • •

FIRST UNITS of facilities for an expanded program of pilot-plant and large-scale research for American industry are nearing completion at Battelle Institute's recently purchased 400-acre site just outside Columbus, Ohio.

The new facilities will be used primarily for large-scale studies in chemical engineering, metallurgy, and minerals processing.

• • •

HARRY A. KULJIAN, president of the Kuljian Corp. of Philadelphia, has been nominated by the Engineers' Week Committee of the Pennsylvania Society of Professional Engineers as the Engineer of 1954. He was cited:

For outstanding engineering achievements as a consultant, designer, and engineer-builder of world-wide stature;

For his phenomenal rise from a humble beginning as an Armenian immigrant, entering America at the age of 16, to the presidency of his own company;

For the numerous power plants and industrial plants designed and constructed by his organization;

For his ability and willingness to accept and understand the aims, ideals, attitudes and even the seeming "eccentricities" of people everywhere;

For his knowledge of world affairs, traditions, economics and human relations.

HERE'S WHAT THEY TELL US

R. C. McKENZIE, Engineer Officer, Veterans Administration Hospital, queried:

> We should like additional information on explanation of water treatment as per an article in the January '54 issue of POWER ENGINEERING. This article was written by a Mr. Waldron.

More data to amplify the article, Comic Characters Help Explain Water Treatment, January '54 issue, page 86, have now been expanded in a very attractive booklet just published by Thomas H. Waldron. It is priced at $1 a copy. All through this booklet, the author uses the same type of humorous but pointed cartoons that were shown as samples in his article.

Executive Editor Chester Earle wrote Mr. McKenzie:

> I know the booklet will help clear up many of the mysteries supposed to lie in water treatment and I can assure you that in my opinion it is well worth the price.

"The heck with my taillight. Where is my trailer?"

E. F. KRYMAN, R. E. Chapin Manufacturing Works, Inc., wants to pare operating costs in the heating of a small plant, and is considering a change from coal to a combination gas-oil burner for his boiler. He asked our opinion and would also like to know about the experiences of other firms.

We sent him names of manufacturers of combination oil and gas burners who have complete catalogs showing details of their burners. Our executive editor also pointed out the importance of providing enough volume in the furnace to secure good combustion without having the oil flame or the gas flame strike the walls or the bottom of the boiler itself. If this meant any remodeling of the furnace, the economy of doing this should be considered.

Executive Editor Chester Earle commented in his note:

> I know one plant that was thinking of converting to gas and oil, and called in a consulting engineer to help them. The first thing he found was that their boilers were very dirty, and said that before recommending a conversion he wanted them chemically cleaned. The plant did this and, just as a result of the boiler cleaning alone, their coal bill dropped from $363 a week to $165 a week.

MONTANA STATE COLLEGE, H. F. Mulliken, Head, Department of Mechanical Engineering, queried:

> If available, I could use 10 copies of Highlights of Atomic Power, January '55 issue, in my classes.

They were sent post haste!

THESE PLEASANT WORDS comprised the postscript of a letter from W. C. Durning, Superintendent of Utilities, Monsanto Chemical Co.:

> I am taking this opportunity to compliment you on your magazine POWER ENGINEERING. I always find it interesting. It certainly fills an important need in the power field.

IN A RECENT LETTER a reader referred to the powdered-coal fuel cell developed by Pittsburgh Consolidation a few years ago. Editor Andrew Kramer replied:

> It seems to me that this development has good possibilities and it will be interesting to see what they do with it during the next two or three years.
>
> In connection with thermo-electric generation, I suppose you have seen the announcement by RCA of the development of an all-electronic refrigeration system. This was disclosed at the New York meeting of the A.Y.E.E. by David Sarnoff of RCA; but I think the term "electronic" is somewhat of a misnomer.
>
> Actually, the device is composed of a large number of reversed thermocouples. It uses the old Peltier effect and when an electric current is sent through these junctions it cools one side of the refrigerator. They actually make ice with it and also cool milk, butter and eggs, just as an ordinary refrigerator does.
>
> Nothing was said about costs, and I am afraid that they are quite high at the present time. I doubt whether this development has great commercial application except for specialized purposes; nevertheless, it is an extremely interesting development.
>
> Mr. Sarnoff did not say what the material of the couples was, but I suspect that germanium or silicon is involved. He did say that this development was the result of further knowledge in solid state physics.

A. C. HUNTER, president, Ralph D. Thomas and Associates, Inc., wrote:

> Have just finished reading your Power Plant Primer and congratulate you on an excellent job. The clear-cut way you have "eased" into the complexities of a modern power plant and the intriguing sketches demonstrate that some engineering college missed getting a good professor.
>
> This will be a very helpful publication for students and other people needing this basic knowledge. It is presented so clearly that those reading it will not only come to realize that a modern power plant, while basically simple, has become a highly complex affair. They will also better appreciate the high caliber of the men who have designed and built the equipment and of the men who operate and maintain it. These two groups deserve a better understanding of their talents and responsibilities by more of the people they serve.

WRITING FOR 30 COPIES of The Power Plant Primer, L. B. Wiggins, Chief Operator, Aqueduct Power Plants, said:

> I like the way you present the material in the articles for the POWER ENGINEERING Handbook very much and feel that you should be highly congratulated for your fine work. I plan to use the Primers as part of a training course for the operators in the power plants under my supervision. If the Primers live up to my expectations I will need more copies in the future.

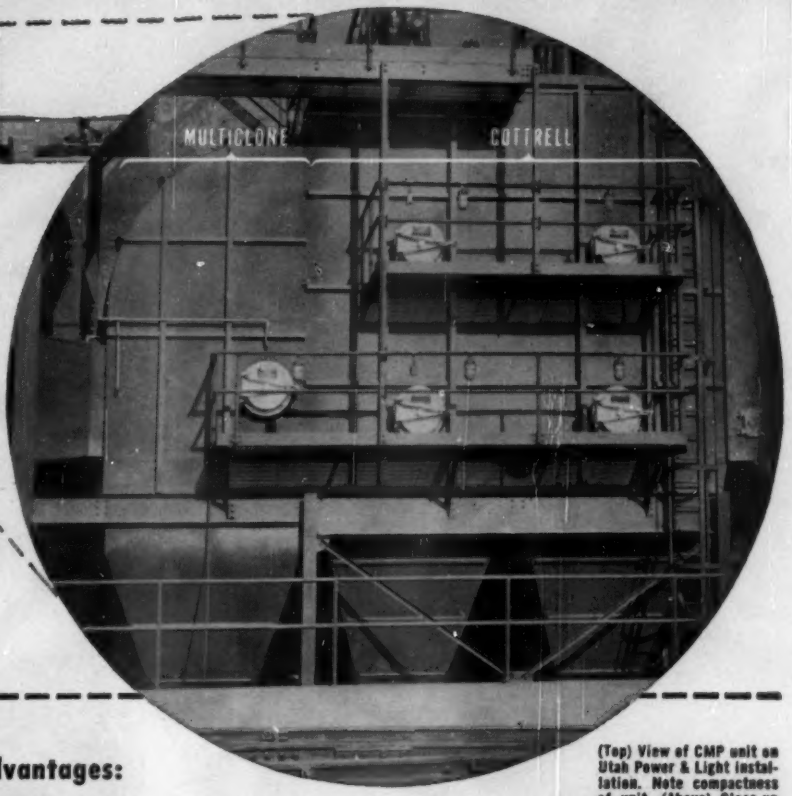
J. H. KLINE, Commonwealth Associates, wrote:

> If the balance of the Primer is as well written as Part I printed in December and January issues of POWER ENGINEERING, I am sure that it will be valuable in training new men, not only in the operation and maintenance of power plants but also in the design of new power plants.

The Power Plant Primer, appearing in the Handbook Section of POWER ENGINEERING'S December '54, January and February '55 issues, is also available in booklet form at $1 a copy. Quantity prices are listed on page 110, February issue.

Planning A Fly Ash Recovery Installation?

Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter)... and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.

2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.

3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down... while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.

4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

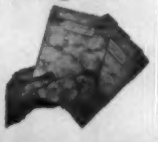
Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields... knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job ... and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!

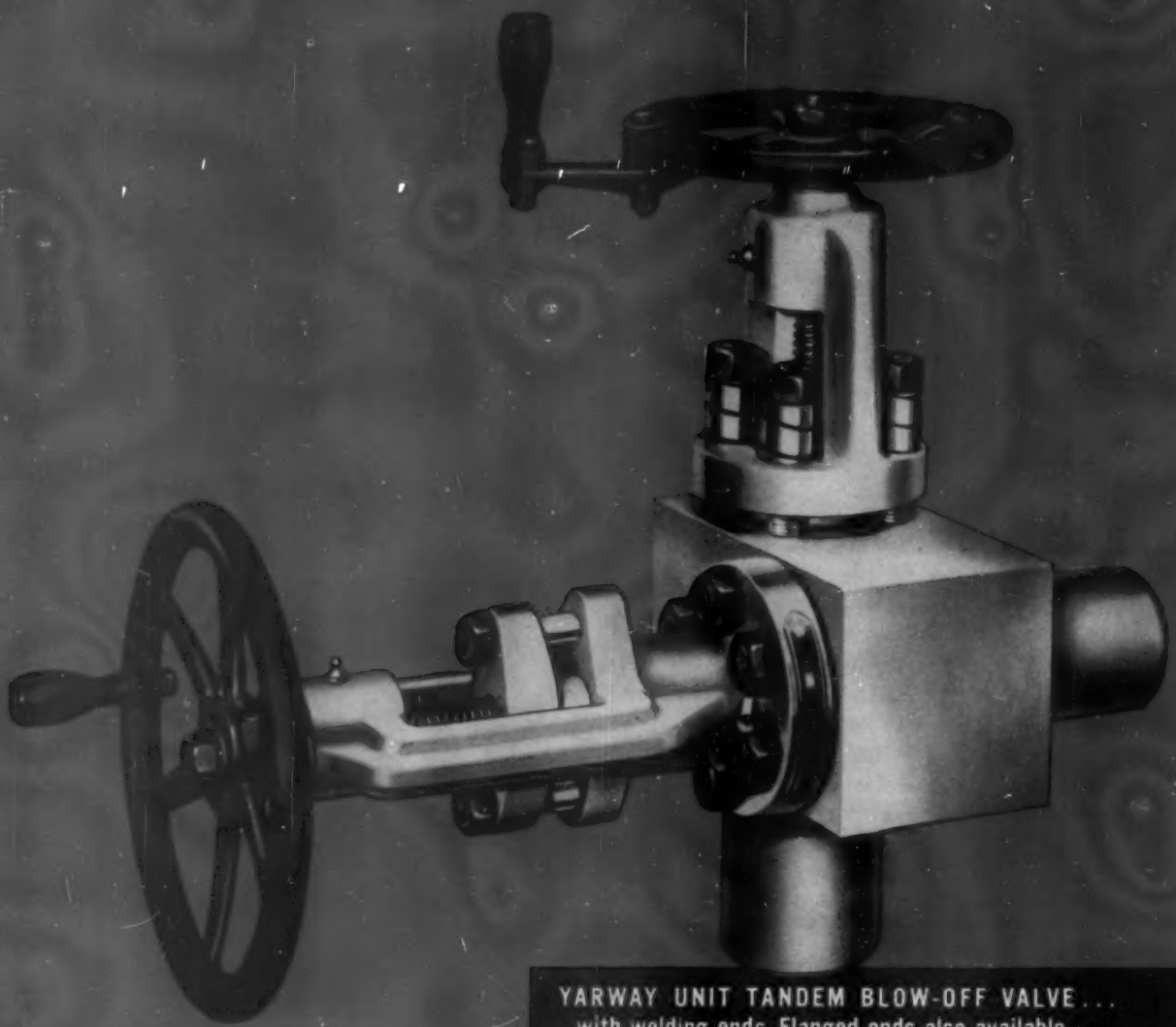


WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 N. La SALLE ST. BLDG., CHICAGO 2
3252 PEACHTREE RD. N.E., ATLANTA 5 • HOBART BLDG., SAN FRANCISCO 4
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

For more data circle 505 on Post Card



YARWAY UNIT TANDEM BLOW-OFF VALVE...
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

● As boiler pressures go up... so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES

Philadelphia Electric Company
Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.

HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

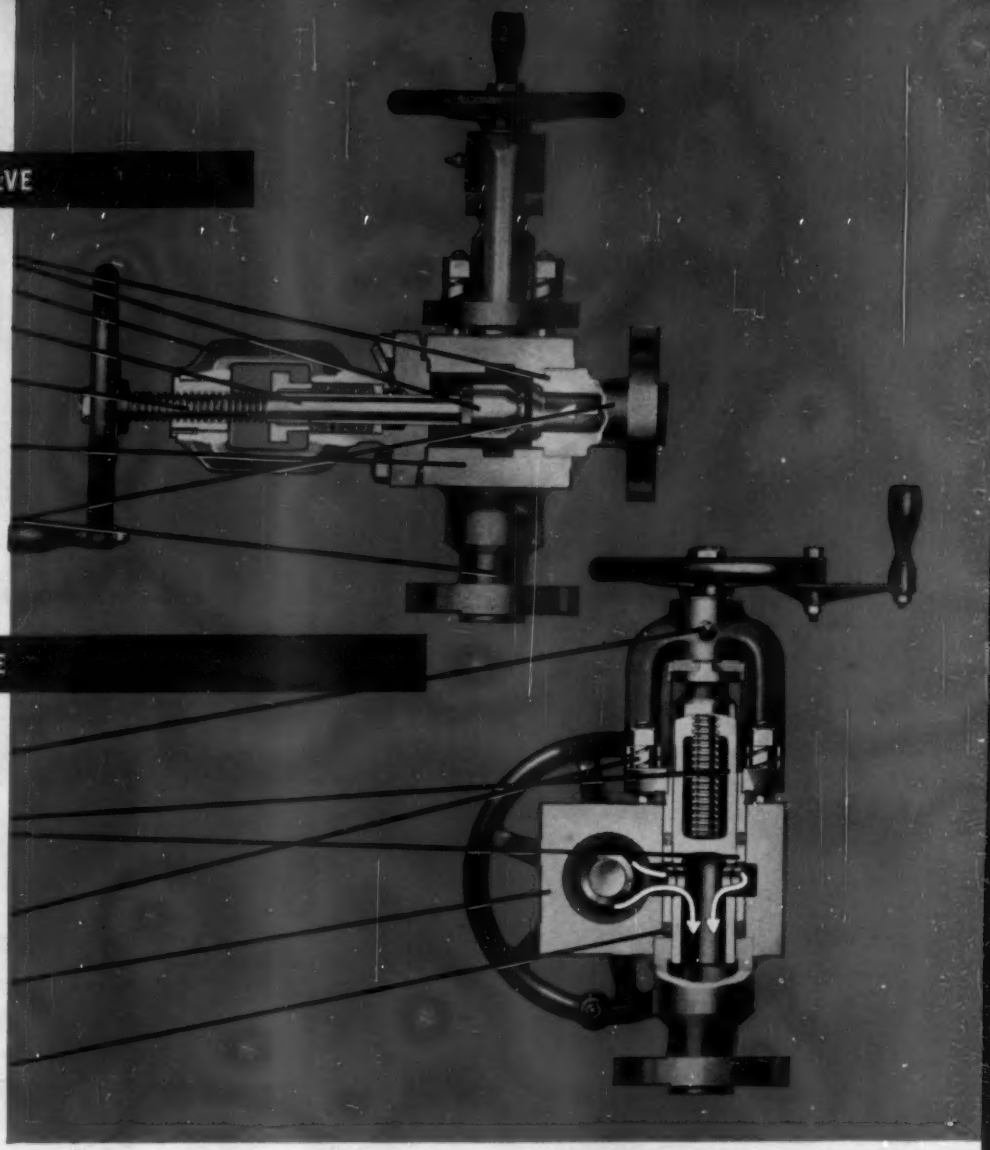
Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.



Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® blow-off valves

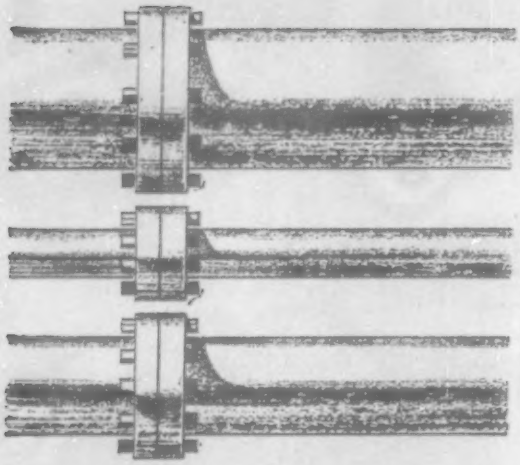
INDUSTRIAL PLANTS

Toledo Edison Company
Georgia Power Company
Union Electric Co. of Missouri
Rochester Gas and Electric Co.
Indianapolis Power and Light Co.

Bethlehem Steel Company
Ford Motor Company
Weyerhaeuser Timber Co.
Anheuser Busch Company
Procter & Gamble Company

Southern Kraft Corporation
Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

This REPUBLIC
Combustion Control System



AUTOMATICALLY SELECTS LOWEST COST COMBINATION OF THREE AVAILABLE FUELS

Three fuels—blast furnace gas, coke oven gas, and fuel oil—are burned by three 125,000 lb. per hr. steam generating boilers at a large midwestern steel plant.

In addition to maintaining the proper fuel-air ratio and holding steam pressure constant at all loads, a Republic Control System automatically makes fuel selections according to the amount of by-product blast furnace gas available. At times when this low cost gas is plentiful, it is used as the primary fuel. The other two fuels are used only for make-up when available blast furnace gas cannot meet all of the fuel demand. If the blast furnace gas pressure falls below a predetermined minimum, however, flow is automatically reduced and one of the other two fuels also burned.

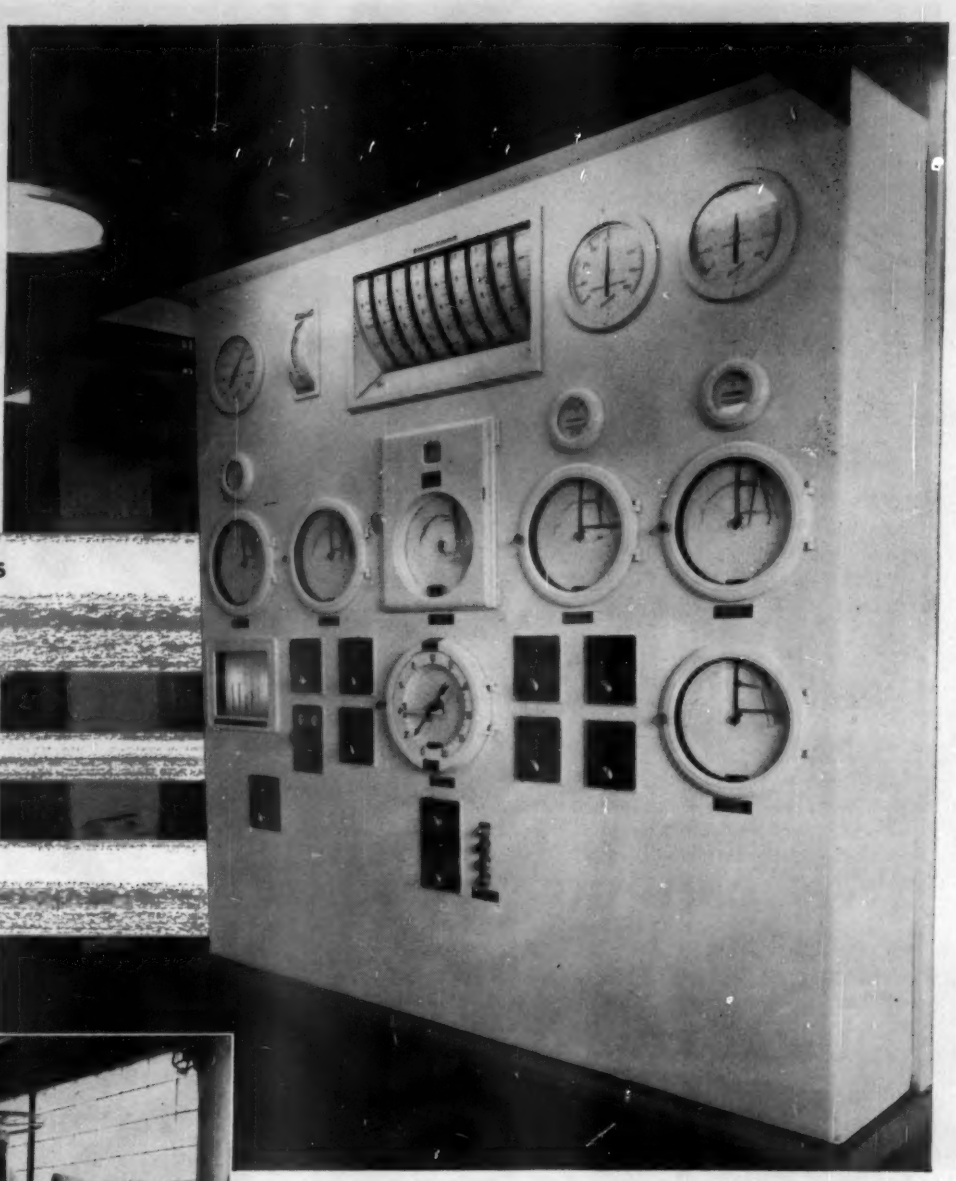
This dual purpose Combustion Control System cuts fuel costs two ways:

(1) Because of efficient combustion, less fuel is used for a given steam output.

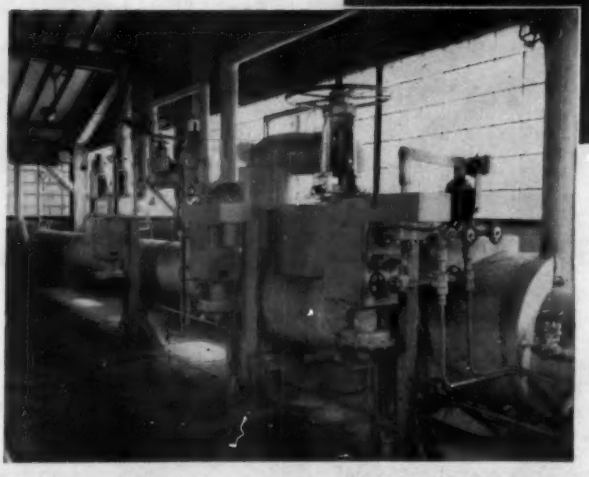
(2) As much lowest cost fuel is used as possible.

Control Systems such as this one further illustrate how Republic engineers can design combustion controls that make the most of fuels available. Very likely, Republic can show *you* ways to get more power at less cost—automatically.

REPUBLIC FLOW METERS CO.



Boiler panel at steel mill power plant includes sub-panels and instruments for multi-fuel firing system. The boiler draft and fuel selection may be controlled manually from this panel, if desired.



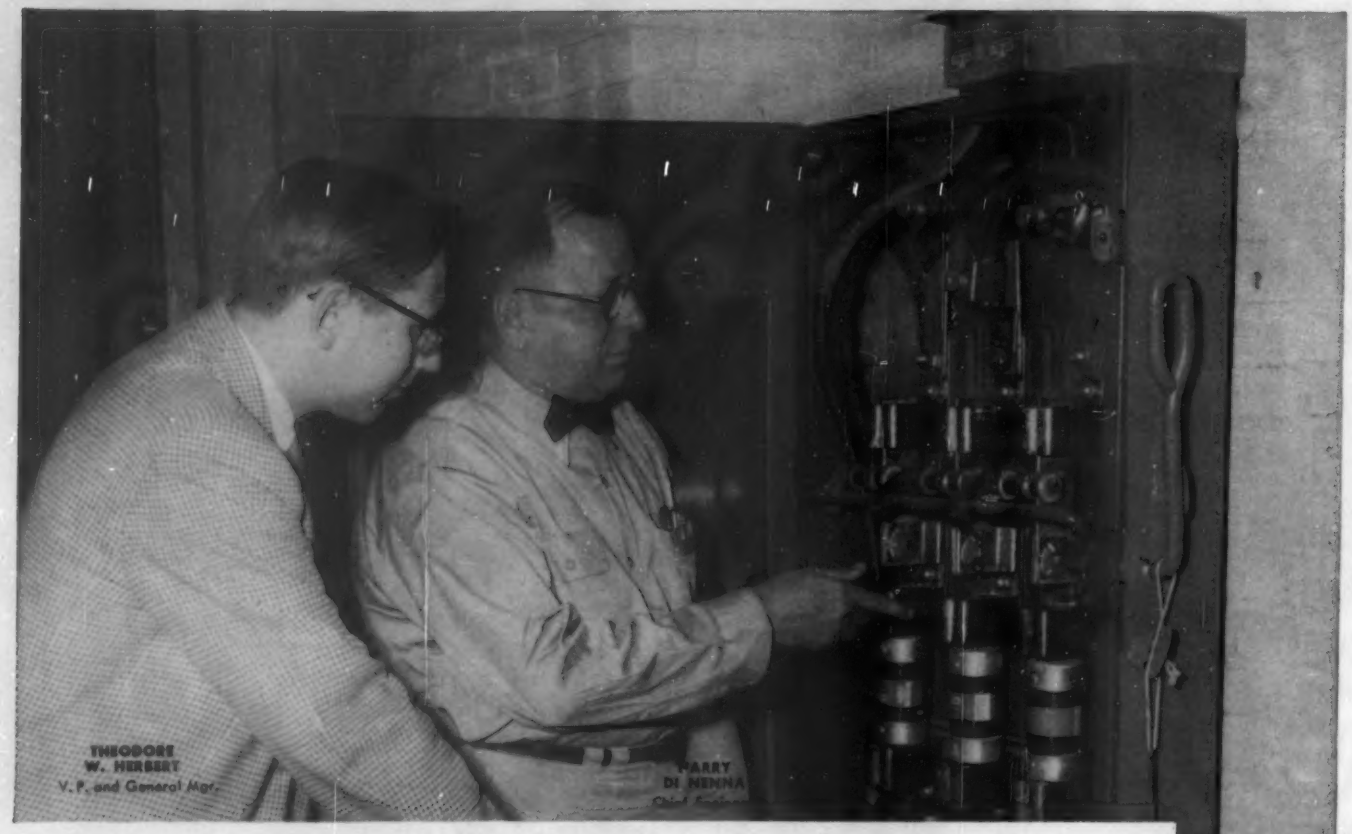
Pressure Reducing and Desuperheating Station furnished by Republic drops steam from 425 psi and 750°F. to 500°F. and 250 psi max.—180 psi min. High and low pressure safety regulators at the desuperheater station protect the boiler system from unusual steam demands.

REPUBLIC AUTOMATIC COMBUSTION CONTROLS

- ★ For all types and sizes of boilers
- ★ For all types of fuel
- ★ For all types of firing
- ★ For all arrangements of draft
- ★ For all load conditions

2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 507 on Post Card



"We can now push our equipment 24 hours a day without fuse blows causing needless shutdowns, thanks to Fusetron *dual-element* Fuses."

"When we are on a tight schedule, we must operate 24 hours a day to fill our orders. Every piece of equipment in the plant is pushed to its limit. A work stoppage of any kind is more than annoying, it is most important as we just can't afford to waste time.

"We were using ordinary fuses to protect our motors, but these fuses couldn't hold up under the pressure. They would blow often and as I now know — needlessly.

"Every time a fuse blew we were losing money. I would start figuring how much harder and faster we would have to work to get back on schedule.

"Something had to be done. We called upon Mr. Paul Serotta of the Norristown Electric Supply Company. He recommended we discard our old fuses and replace them with Fusetron dual-element fuses.

"That was the answer all right. We can really notice the difference. Now, when we are on full production basis I am not worried that our equipment will be out of operation by the needless blowing of fuses."

Harry DiNenna
CHIEF ENGINEER
HERBERT HOSIERY COMPANY
NORRISTOWN, PA.

Play Safe! install Fusetron and BUSS Hi-Cap

Fusetron Fuses Do More Than Eliminate Shutdowns Caused By Needless Blows...

FUSETRON FUSES PROVIDE 10 POINT PROTECTION...

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

FUSETRON FUSES SAVE YOU Maintenance and Recalibration Costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you have installed has been *calibrated at the factory by engineers* — it is a fuse as safe and dependable as the one that blew.

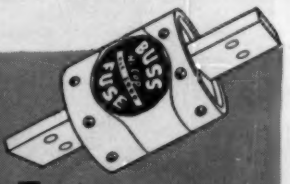
FUSETRON FUSES GIVE YOU GREATER SAFETY, BECAUSE OF THEIR HIGH INTERRUPTING CAPACITY

Tests verified by the Electrical Testing Laboratories of New York indicate that Fusetron fuses can interrupt safely the most severe available short-circuit current.

The tests circuits were set to deliver in excess of 100,000 amps. In each test the fuse cleared the circuit safely, the fuse remained intact, there was very little noise and cotton packed around the fuse was not ignited.

Yet there has been no interference with the time-lag characteristic of Fusetron fuses.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., BUSS Hi-Cap FUSES PROVIDE...



Unlimited interrupting capacity to handle any fault current regardless of system growth! This was confirmed by tests witnessed and reported upon by the Electrical Testing Laboratories of New York.

Overload protection as well as short-circuit protection.

Coordination with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

On old installations, a safe and relatively inexpensive way to protect inadequate circuit breakers against rupture in event of bad fault.

Dependable service through the years because there are no moving parts to stick or get out of order.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Blowing time charts and more information are available on FUSETRON Fuses and BUSS Hi-Cap fuses. Write for bulletin FIS and HCS.

BUSSMANN MFG. CO., (Division of McGraw Electric Company) University at Jefferson, St. Louis 7, Mo.

Fuses throughout the entire Electrical System!

For more data circle 508 on Post Card

Dearborn®

LEADER IN WATER CONDITIONING AND RUST PREVENTION

DEARBORN CHEMICAL COMPANY • MERCHANDISE MART PLAZA • CHICAGO 54, ILL.

what's wrong with H_2O?

Nothing...except that it's so rarely found in its pure state. Even rain, nature's closest approach to pure water, contains carbon dioxide and dissolved oxygen. So it is, in varying degrees, with every surface or underground water supply. All waters have certain corrosive impurities that must be corrected or neutralized before they can be economically used. There's where we come in.

Since 1887, Dearborn has worked with water to make water work better and more economically for you. That's why, today, industrial and commercial businesses of every size and type look to Dearborn for consultation and assistance in—

- ★ **Internal or external feed water treatment**
- ★ **Steam purity control**
- ★ **Feeding, softening or de-ionizing equipment**
- ★ **Cooling water or process water treatment**
- ★ **Water reclamation**
- ★ **Treating industrial waste**

This broad experience of Dearborn's is available to you. Your Dearborn Water Treatment Engineer will gladly explain the advantages of Dearborn Supervisory Service—a program in which you use only the amount of service you need.

Why not investigate? There's no obligation.

MAIL THE COUPON!

Dearborn Chemical Company Dept. PG
Merchandise Mart Plaza, Chicago 54, Illinois

☐ Please furnish more information on Dearborn Water Conditioning

☐ Have a Dearborn Water Treatment Engineer call

Name.....*Title*.....

Company.....

Address.....

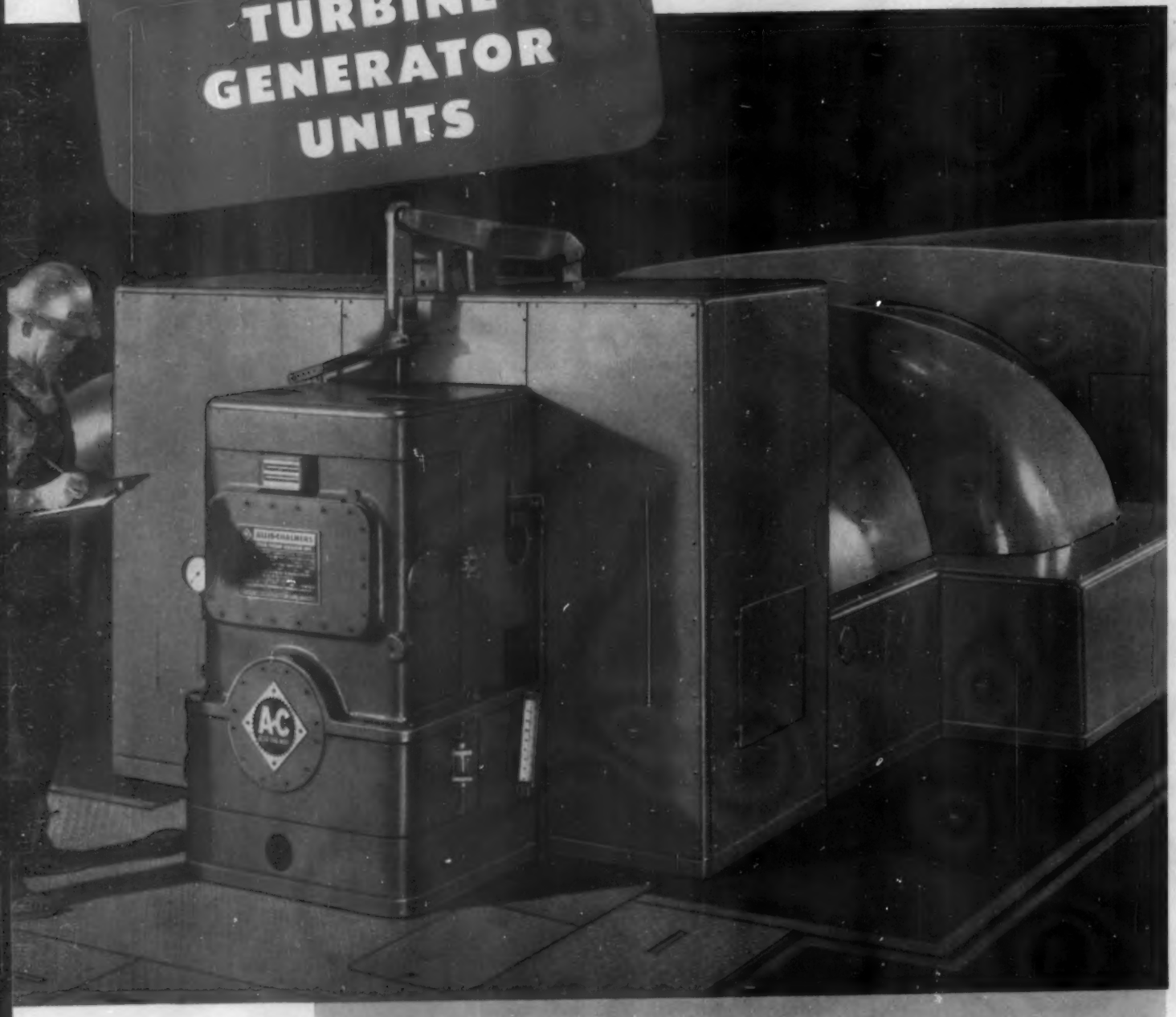
City.....*Zone*.....*State*.....

For more data circle 509 on Post Card

Choice for

WA-Series

STEAM TURBINE GENERATOR UNITS



COMPLETE POWER PLANT at Tuscola includes three boilers and two WA-Series steam turbine generator units, shown above. Allis-Chalmers also supplied condensers and condensate pumps for the plant.

ALLIS-

New $44,000,000 Petro-chemical Plant

Two units generate power as by-product from steam required for processing natural gas

NATIONAL PETRO-CHEMICAL CORPORATION'S new Tuscola, Illinois, plant takes up to 425 million cubic feet of natural gas from the adjacent Panhandle Eastern pipeline, extracts 10 million cubic feet of ethane for cracking into valuable industrial chemicals, and returns the gas to the pipeline for transportation to big city customers.

To synthesize this huge amount of ethane into ethylene, hydrogen, and later into other useful components, fractionation and low temperature separation are used. The processes require 600,000 pounds per hour of steam, which is produced at 625 psig, 750 F.

Two condensing, automatic extraction WA-Series steam turbine generators are utilized to produce 10,000 kw of power from the steam before it is delivered into plant processes. The steam is delivered directly into the high temperature side of the automatic extraction impulse turbines, from which it is extracted at 65 psig for use in the plant. Each turbine generator unit is equipped with a housing-type, air-cooled generator and exciter. The entire units are carefully engineered and manufactured to operate as integrated units, 24 hours a day, 7 days a week.

WA-Series steam turbine generator units match the most modern plant design to provide high efficiency power or process steam. They are available in condensing or non-condensing types in NEMA ratings 2000 kw and larger. Bulletin 03B7654 gives complete facts. For your copy just call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4477

OUTBOARD END of one unit shows exciter housing.

Simplified Installation and Maintenance

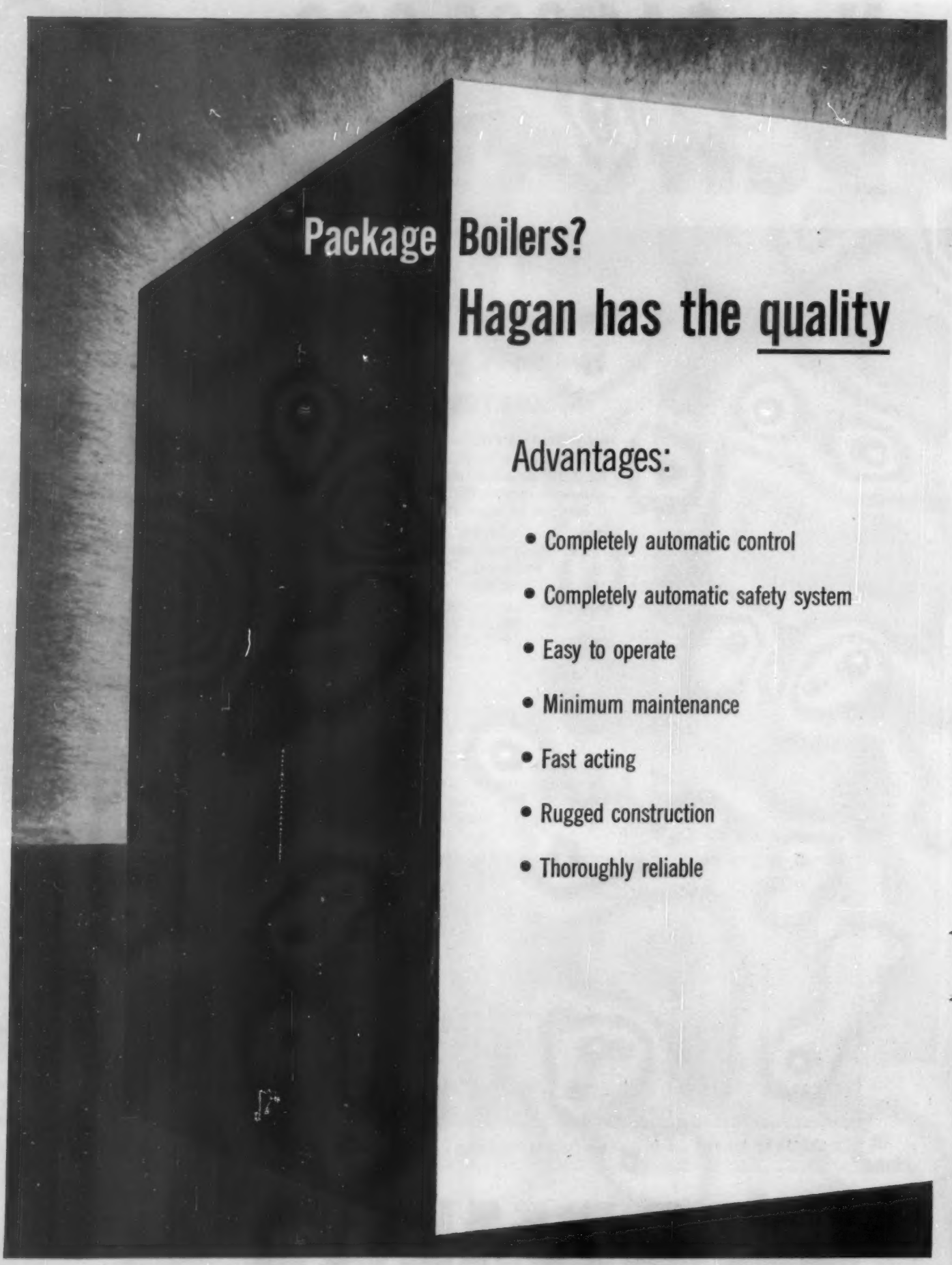
Every detail of WA-Series steam turbine generator units is designed for maximum simplicity and maintenance. Three-bearing construction, above-the-floor oil piping, and bracket-bearing, housing-type air-cooled generator are some of the features that result in a compact unit with simplified installation requirements. Turbine and generator are shipped with their rotors locked in place, further minimizing installation time.

Maximum reliability is assured by labyrinth spring-back steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and a time-proved governing system.

CHALMERS

A-C ALLIS-CHALMERS

For more data circle 510 on Post Card



Package Boilers?

Hagan has the quality

Advantages:

- Completely automatic control
- Completely automatic safety system
- Easy to operate
- Minimum maintenance
- Fast acting
- Rugged construction
- Thoroughly reliable

package control to fit your boiler!

Hagan offers a quality control system for your packaged boiler. The Hagan pneumatic Combustion Control System is combined with an automatic and programmed ignition system, both containing adequate safety interlocks. The whole is integrated into a factory pre-assembled and tested control center. Hagan pneumatic systems are easy to operate, will last as long as the boiler, and give you complete control and records.

Each of the six Hagan Control Packages is engineered to meet "big boiler" standards, both in respect to accuracy of control, and to dependability. All of the systems are . . .

SAFE

The safety system is complete, and so integrated with combustion control that the boiler *cannot* be operated, or if in operation, will *automatically* shut down and set off alarms, if a dangerous condition exists with respect to excessive steam pressure, low water level, low oil pressure or temperature, low gas pressure, low wind box pressure or any electric failure.

AUTOMATIC

Both combustion control system and the safety system are entirely automatic . . . here is practical "pushbutton" operation. The system is rugged and extremely simple to operate and adjust. Specialized personnel or test and maintenance equipment is not needed. A Hagan system is fast, and will function efficiently with minimum attention and minimum maintenance.

EFFICIENT

Hagan Automatic Combustion Control provides the most favorable fuel burning efficiency. Since annual fuel costs can easily exceed the total cost of boiler and controls, the gain in efficiency with Hagan control will insure maximum return on the investment in a really complete control system. Hagan Systems are designed to produce high combustion efficiency.

• Write for Hagan Bulletin No. MSA 128 for the full story on Package Boilers and Hagan Package Control Systems.

Specify Hagan Quality Control for Your Package Boiler!

HAGAN HALL BUROMIN CALGON

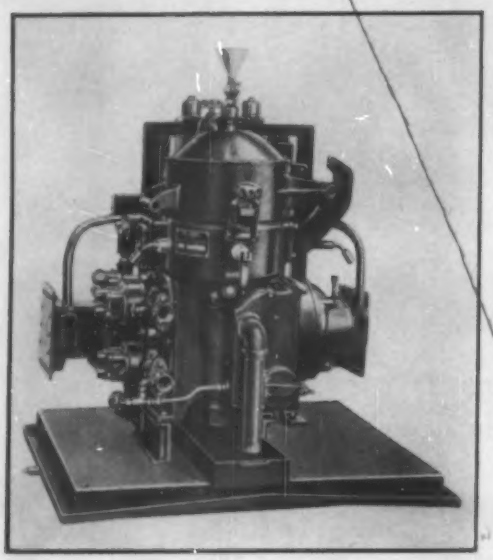
HAGAN CORPORATION

Hagan Building • Pittsburgh 30, Pennsylvania

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Aeronautical and Automotive Testing Facilities

For more data circle 511 on Post Card

DO YOU GET ALL THE "ENDURANCE VALUE" OUT OF YOUR TURBINE LUBE OIL?



The refiners of your turbine lubricating oil gave it high "endurance value" . . . continued stability and resistance to breakdown . . . long-lasting wetting ability . . . film strength . . . adhesion.

Keep *all* the value they put into the oil . . . by keeping it clean and dry . . . with a *De Laval* Turbine Oil Purifier.

De Laval provides maximum protection for your turbines. There is a type and size to fit every installation . . . to keep oil *clean* . . . keep it *dry* . . . day after day, month after month, year after year!

DE LAVAL

lubricating oil purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 61 Beale St., San Francisco 5

For more data circle 512 on Post Card

Allis-Chalmers Supplementary Treatment

Eliminates All Scale!

WATER SOFTENING PLANTS SELDOM REMOVE all scale-forming material. In fact, only one part per million of hardness in feedwater will amount to twenty pounds of scale or sludge after twenty million pounds of steam is generated. In even a short period, this build-up can cause serious trouble. In addition, condensate is frequently contaminated.

To solve this problem, Allis-Chalmers has developed its supplementary treatments, which are formulated specifically to the requirements of individual plants.

You can find out about factors involved in designing the proper supplementary treatment in Allis-Chalmers Water Conditioning Informational Bulletin 52. It explains how Allis-Chalmers water conditioning engineers approach this problem. Get a copy from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

A-4594

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

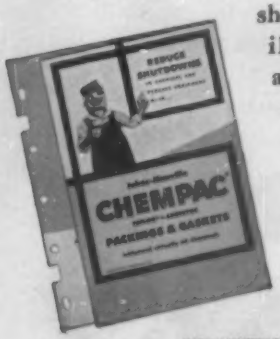
A-C ALLIS-CHALMERS

For more data circle 513 on Post Card

Now—J-M Chempac-Interlocked Packing combines both "Teflon" and asbestos protection

Johns-Manville now introduces Chempac®-Interlocked Packing, with three important advantages for service in chemical and process equipment. Interlocked provides the excellent sealing and heat resistant qualities of asbestos. It is braided by the unique and exclusive J-M method, so that the asbestos yarns are securely interlocked and cannot come apart in service. And it is treated with chemically inert Teflon*, which is almost universally resistant to chemical and solvent action.

Chempac-Interlocked can be used to pack pump rods or shafts, rotary filters, mixers and similar apparatus handling strong acids, alkalis, caustic solutions and many other reagents at temperatures to 500F.



Other J-M Chempac Packings and Gaskets for the Chemical and process industries

J-M Chempac Packings in coil, spiral and ring form. Made of asbestos, treated with Teflon, they are available in types for caustic, acid, chlorine and solvent service.

J-M Chempac Gaskets with Asbestos-Teflon base. They have high mechanical strength and heat resistance, with excellent sealability at low bolt stresses.

J-M Chempac Folded Gaskets designed for glass lined equipment. Asbestos-Teflon base gives them high sealing effectiveness against a wide range of chemicals.

J-M Chempac Spirotallic Flange Gaskets for perfect sealing in high temperature and pressure service, constructed of interlocked plies of metal and Teflon-Asbestos.

*Trade Mark of DuPont Tetrafluoroethylene resin

Free Folder gives complete details on Chempac-Interlocked and other J-M Chempac Packings and Gaskets for the chemical and process industries. For your copy of folder PK-80A write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

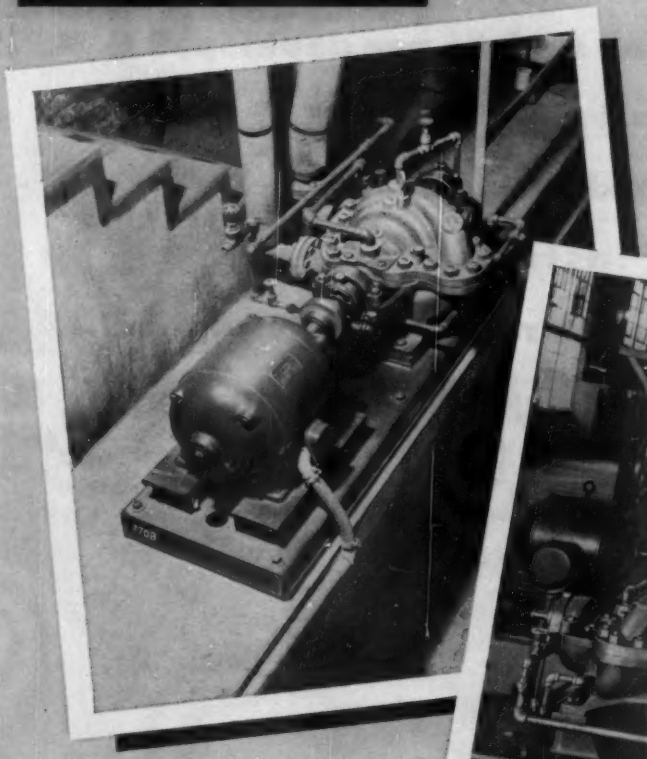
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

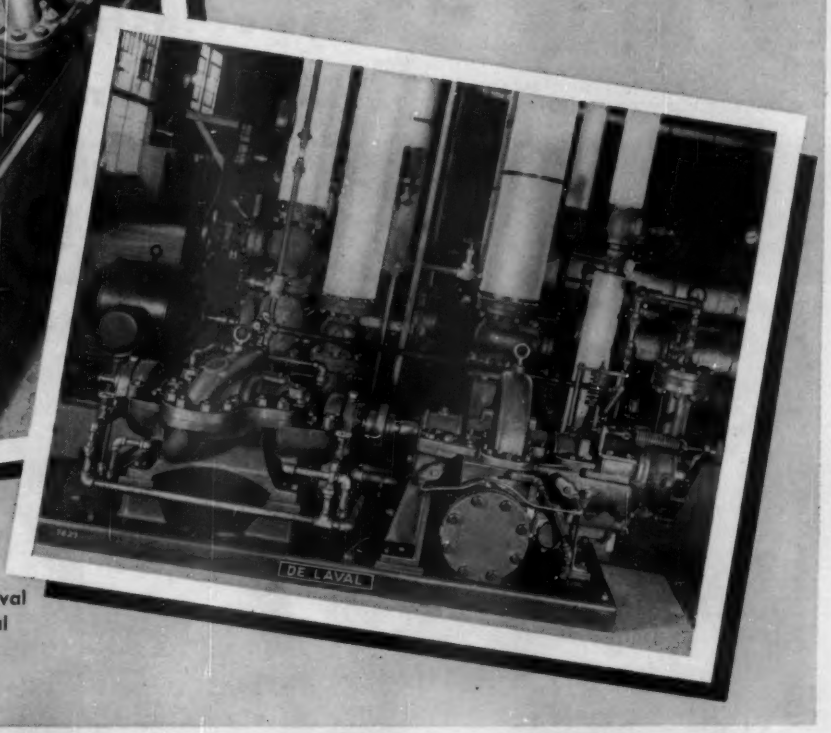
For more data circle 514 on Post Card

DE LAVAL
TWO-STAGE HORIZONTAL PUMPS

for dependable boiler feed service in institutions . . . industrial plants



Institutions can't afford shutdowns. In this hospital installation a motor-driven 21S boiler feed pump provides year-in, year-out dependability. It delivers 70 gpm of 240° water at 420 ft. head.



Industrial plants, too, choose reliable De Laval pumps for boiler feed service. This De Laval unit, driven by a De Laval turbine, delivers 160 gpm of 215° water at 520 ft. head.

There are good reasons why De Laval 21S-2KS two-stage horizontal split case pumps give long, economical boiler feed service. They are designed with • back-to-back impellers for balanced hydraulic thrust • easily replaceable threaded impeller wearing rings • long life labyrinth case rings • ring oiled ball bearings — plus ten other important design features.

These De Laval pumps are available in sizes from 2" to 8" discharge, for capacities from 75 to 3,000 gpm and heads to 750 ft.

Write for Bulletin 1501 giving complete data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

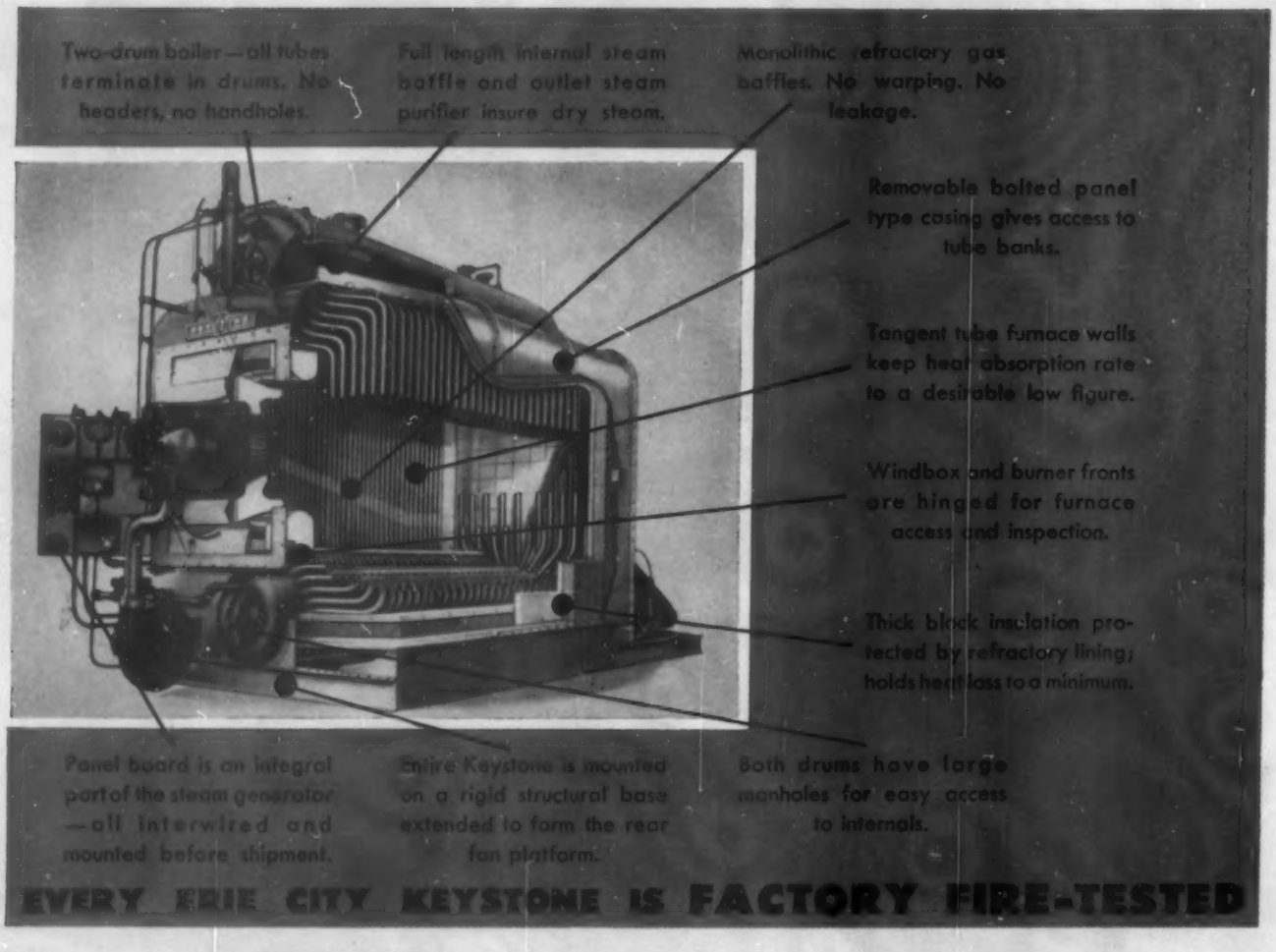
816 Nottingham Way, Trenton 2, New Jersey

KEYSTONE STEAM GENERATORS

are RELIABLE *and* ECONOMICAL *to operate*

Here's Why

- **5 Sq. Ft. of heating surface per developed H. P.**
- **Fully automatic controls**
- **All piping and wiring at the factory**
- **Ease of installation**
- **Low cost maintenance**


Two-drum boiler—all tubes terminate in drums. No headers, no handholes.
Full length internal steam baffle and outlet steam purifier insure dry steam.
Monolithic refractory gas baffles. No warping. No leakage.
Removable bolted panel type casing gives access to tube banks.
Tangent tube furnace walls keep heat absorption rate to a desirable low figure.
Windbox and burner fronts are hinged for furnace access and inspection.
Thick block insulation protected by refractory lining; holds heat loss to a minimum.
Panel board is an integral part of the steam generator—all interwired and mounted before shipment.
Entire Keystone is mounted on a rigid structural base extended to form the rear fan platform.
Both drums have large manholes for easy access to internals.

EVERY ERIE CITY KEYSTONE IS FACTORY FIRE-TESTED

ERIE CITY
75 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

For more data circle 515 on Post Card

HELPFUL BULLETINS

PUMPS AND COMPRESSORS

101 General Purpose Pumps — Bulletin 08B8233 describes Type KS pump, developed for air conditioning and general purpose applications. Points out construction features with the aid of a cutaway drawing, and includes bearing and sealing details. Allis-Chalmers Mfg. Co.

102 On Vertical Pumps — This 16-pp bulletin describes and illustrates application of vertical industrial service pumps for liquid transfer from short settings in both industrial and process services. Points out advantages and describes three basic designs. Stresses versatility of the pumps due to design flexibility. Also gives general recommendations for obtaining optimum performance, and includes photos of typical installations. Peerless Pump Div., Food Machinery and Chemical Corp.

103 Steam Pump — Bulletin 230 describes a horizontal duplex steam pump with piston valve steam chest. Explains advantages of this construction, including high recovery of fuel cost when exhaust steam is utilized. Provides sectional and exterior views of the pump, also specifications, capacities and dimensions. Warren Steam Pump Co., Inc.

104 Rotary Pumps — Eight-pp Catalog 955 covers briefly this company's line of pump products and explains and illustrates operating principle utilized. Gives construction features, mounting information and size and capacity data for the Series 3600 series for liquids at slow speeds; the compact Series K; the Series F for pumping clean liquids; and the new Series 1600 pump-motors. Geo. D. Roper Corp.

105 Centrifugal Pumps — Eight-pp Bulletin 105-B describes company's type O horizontal split case, double suction centrifugal pumps. Gives construction details and includes suggested specifications, a dimension chart and selection table showing range of output and heads. Cutaway views with parts lists illustrate the three types which comprise the series. Photos illustrate typical applications. Aurora Pump Div., New York Air Brake Co.

106 Centrifugal Pumps — Twelve-pp Bulletin 722.6 describes company's two-stage centrifugal pumps with horizontally split case and opposed impellers. Contains information on specifications, materials of construction, and mechanical details, and includes performance curves, and charts showing parts interchangeability. Goulds Pumps, Inc.

107 Seal-less Centrifugal Pump — Bulletin 1010, 16-pp, presents detailed data on company's line of sealless, centrifugal pumps. Gives information on sizes, horsepowers, heads and capacities, dimensions, materials of construction, design data, construction features and direct user benefits. Three new models are introduced, with design and construction information — six different model series are described altogether. These range in sizes from ⅛ to 7½ hp, heads to 195 ft, capacities to 250 gpm. Chempump Corp.

108 Centrifugal Pumps — Packingless self-priming centrifugal pumps are discussed in 12-pp Bulletin G-1. Explains how pumps are designed to provide an effective seal without packing. Provides instructions for installation and care of these pumps, as well as operating information. Booklet features company's Type CG pump for both flooded suction and suction lift. The LaBour Co., Inc.

109 Rotary Pumps — Bulletin W-484-B2B describes company's rotary pumps with herringbone gears. Provides information on diversified applications, specifications and dimensions. A performance chart gives data on speed, capacity, pressure and power requirements of various pump sizes. Motor frame dimensions in relation to pump sizes are listed. Worthington Corp.

110 Heavy-Duty Compressors — Bulletin 601, 6 pp, introduces this company's Class ATH horizontal, double-acting, heavy-duty water-cooled air and gas compressors of the sectionalized cylinder type. Text stresses long-time continuous low-cost service, other advantages of these compressors. Explains how the new design requires less cooling water and lower horsepower. Construction features are illustrated; sizes, ratings included. Pennsylvania Pump & Compressor Co.

111 Non-Portable Compressors — Publication PR-725 is an article on non-portable compressors, their installation and maintenance. Covers such topics as location; foundation shaking forces; soil considerations; foundation suggestions; piping; location of inter- and after-coolers and receivers; temperatures; lubrication, inspection and maintenance information. Worthington Corp.

112 Water Cooled Compressors — Eight-pp Form 1000A describes and pictures a line of water cooled air compressors. A keyed cutaway illustration shows main design features of these compressors, and dimensions, specifications and operational details provided. Quincy Compressor Co.

ENGINES

113 Efficient Engine Design — Catalog E-9, 8-pp, describes and illustrates company's 115 to 410 hp engines with valve-in-head design. Bulletin uses cutaway views and photos to point out distinctive features and gives full specifications. Le Roi Division, Westinghouse Air Brake Co.

114 Continuous Duty Engine — Bulletin S-500-B42B, 10-pp, presents information on construction details, applications and latest design features on company's diesel engines for continuous heavy-duty service. A 3-pp schematic diagram illustrates various component parts and full specifications are included. Fuel costs per gal are shown on separate charts for oil, natural gas and propane along with a horsepower ratings chart for the engines. Worthington Corp.

115 Engine Insurance — Sixteen-pp Booklet 800 contains information on lengthening life of engines and avoiding periods of operation during which excessive wear occurs. Relates some U. S. Navy experience with wear measurement, explains effect of fuel in the crankcase, discusses meaning of viscosity, and stresses value of an accurate indicator on the engine. The Gerin Corp.

VALVES, PIPING AND FITTINGS

116 Cushioned Valves — Double cushioned electric check valves designed to solve problems commonly associated with check valve installations are described in this 8-pp Bulletin W-10. Comprehensive in its coverage of pertinent data, bulletin includes dimensions, cross-sectional drawings with parts list, suggested wiring diagrams and specifications. Golden-Anderson Valve Specialty Co.

117 Solenoid Valve — This 12-pp catalog, Folder 215, offers technical information on the Electro-Mite — a combination solenoid valve, flow rate control and inlet strainer. Flow rate charts and standardized specifications are included. Hays Mfg. Co.

118 Fluid Control Valves — Needle valves, toggle valves, plug type valves and packless diaphragm valves are described and illustrated in 12-pp Bulletin 3037. These valves are designed for use in instrumentation, pharmaceutical work, air circuit applications, vacuum systems and pressure flow control. Booklet provides suggestions on application of the valves shown, discusses major features and includes sizes. The Imperial Brass Mfg. Co.

119 Valve Comparison Chart — Valuable in specifying, ordering, and using of bronze and iron-body valves, this chart lists figure numbers of valves that are equivalent in application, notes major differences in construction. It provides simple, easy to read tables detailing company's line of bronze and iron-body valves compared with valves of other leading manufacturers. The Fairbanks Co.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 119-120

120 Plastic Pipe, Fittings — How to use and specify rigid plastic pipe and fittings is told in this 12-pp catalog. Provides reference data on a ½- to 4-in. line of normal and high impact unplasticized polyvinyl chloride pipe and fittings, plus properties and characteristics, together with detailed drawings and specifications of solvent-type fittings and other fittings. Alpha Plastics, Inc.

121 Pipe Connections — Catalog 55, 12-pp, describes company's line of pipe connections, unions, and bleeder valves. Discusses all-steel sealing with pressure-aided seat which is incorporated into a pipe connection and union with ranges from ½ to 12 in. and vent-drain-bleeder. Descriptions are given of applications which simplify and improve piping systems, as well as test results. In addition, book gives data on construction, operation, advantages, specifications, dimensions, pressure ratings and prices. Gray Tool Co.

122 Forged Steel Unions —Bulletin U-1 describes company's forged steel unions, listing dimensions in sizes ⅛ to 2 in. in 3,000 lb class. Design features which make the unions desirable for high pressure service and for resistance to shock, vibration and misalignment stresses are fully described. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

BOILERS

123 Steel Boilers — Revised General Catalog 80, 32-pp, is a condensed but complete product guide on company's high and low pressure steel boilers for commercial, industrial use. Also included are full descriptions and illustrations of water heating products, both direct fired and storage types as well as indirect water heating coils. Pages on boiler support brackets, structural steel suspension and induced draft fans, as well as pictures of typical boiler installations complete the manual. Kewanee-Ross Corp.

124 Self-Contained Boilers — Brochure AD-137 covers company's LR and CB models of self-contained boilers. Compactness in design is illustrated, and advantages of the units listed. Suggested boiler room layout and dimensions are included, also specifications on both models. Cleaver-Brooks Co.

MECHANICAL POWER TRANSMISSION

128 Gear Products Guide — This 200-pp catalog lists specifications and prices of over 8000 stock items, including gears, sprockets, chains and splines. Considerable space is devoted to company's drilling units, dust collectors, coolant systems, grinders, and other related items. Manufacturing facilities of company are pictorially treated and catalog is profusely illustrated with photos, diagrams, and charts. Services available for designing and building of tools, dies, jigs, fixtures, special gears, machines are also noted. Universal Gear Works.

129 Power Transmission Machinery — Engineering Catalog D 55, 304 pp, covers a full line of speed reducers, V-belt drives, belts, sprockets, sheaves, chains, clutches, couplings, shafting, bearings, Taper-Lock bushings and other power transmission machinery. Besides providing sizes, ratings and necessary ordering information, this book offers helpful suggestions on selection of equipment, as well as tips on its use and maintenance. Includes tables giving weights and properties of round steel shafting, circumferences and areas of circles, trigonometric functions, strength and physical properties of materials, and engineering formulas. Available to qualified power engineers, please state your job title. Dodge Mfg. Corp.

130 Flexible Couplings — Catalog 55-A, 24 pp, presents a line of rubber-bronze bushed flexible couplings, explaining how they work and what they are designed to do, and providing ratings and service factors. Gives data on forged steel and cast semi-steel couplings for heavy duty use, shear pin couplings, brake drum couplings, flange type of bolting to flywheels, other types. Includes dimensions. Ajax Flexible Coupling Co., Inc.

. . . Outstanding Among This Month's Catalogs . . .

125 Turbine-Generator — Bulletin GEA-3277C, 54-pp, describes turbine-generators rated from 2500 to 40,000 kw. Condensing and non-condensing applications for electric utilities and industrial plants as well as special applications are covered. Cross-sections, schematic drawings, and installation photos are provided. Also detailed are condensing and non-condensing single and double-automatic-extraction, condensing double flow exhaust, and triple-automatic-extraction units. Discusses operation of governing system, valve gears, ventilating and cooling systems, and design and manufacturing features. General Electric Co.

126 Jet Apparatus — Bulletin J-1, 12-pp, is designed to help power engineers select jet apparatus for specific requirements. Includes basic information on the jet principle, jet apparatus terminology, and data on jet construction, operation, and advantages offered. Various functions performed by jet apparatus are outlined, types best suited for each function identified, and each type described. Includes sectional drawings. Schutte and Koerting Co.

127 Guide to Luminaires — Pocket-size, 28-pp Bulletin B-5799-B covers fluorescent luminaires for commercial and industrial use. Summarizes salient features of each type of luminaire as it discusses electrical characteristics, maintenance and mounting data, details of constructions, dimensions, and recommendations for application. Also contains a pictorial guide to floodlights and incandescent luminaires for industrial and other use. A tabulation of buying data concentrates information needed for procurement. Westinghouse Electric Corp.

131 Steam Heating Refresher Course — "What You Should Know About Modern Steam Heating," 16-pp, is a concise source of information for evaluating steam as a heating medium for specific types of installations. An outline for steam heat system specification is a checklist guide for specifying a heating system with steam; it covers 33 points from general conditions to final tests. Starting with a section on basic steam physics, booklet relates characteristics of steam to specific efficiencies and benefits. Covers types of buildings, equipment and heating requirements served economically by steam. Problems of heating control maintenance are discussed. Steam Heating Manufacturers Ass'n.

132 Worm Gear Sets — Ratings and specifications on a line of worm gear sets are presented in 24-pp Engineering Manual SW 1. Provides load characteristics and detailed selection information, also dimensions and part numbers. These worm gear sets are available in standard ratios from 4½ to 71, and have application in cranes and hoists, machine tools, furnace drives and metal mills. Foote Bros. Gear and Machine Corp.

133 Motorized Reducers — Of practical interest to power engineers concerned with gear drives up through 75 hp rating, is 28-pp Bulletin 3100–1954. It consolidates selection tables, dimensions, weights, overhung load ratings, and thrust capacity ratings needed to select horizontal, vertical, or right-angle motorized reducers in all-motor or integral design. A foldout section bound into the middle of the book contains illustrated information on mounting positions, low speed shaft connections, and product features. The Falk Corp.

134 Steel Pulleys — A pictorial review of this company's steel pulleys, their manufacturing processes and some of their end uses is provided in this 16-pp brochure. Shown and briefly described are the manufacturing techniques and skills required to produce these pulleys for power transmission, material conveying, heating and air conditioning and other requirements. American Pulley Co.

INSTRUMENTS AND CONTROLS

135 Mechanical Instruments — Circular M-2-B, 48 pp, describes and illustrates dial indicating thermometers, recorders, controllers, their accessories, and diaphragm motor valves. In this book, descriptive literature has been kept to a minimum with special emphasis given to basic engineering information and specifications to provide an easy reference for selecting the proper instrument. Weston Electrical Instrument Corp.

136 For Industrial Measurement — Design and operation of a line of stainless steel industrial meters for specific applications in the chemical, petrochemical, and other fields are described in 12-pp Bulletin O.G. 406. Also described are two types of accessory equipment for use with meters: remote registration equipment for centralized batching and flow control; and multi-stage quantity control valves to eliminate hydraulic line shock from abrupt shut-off. Meter operation is illustrated. Meter and Valve Div., Rockwell Mfg. Co.

137 Temperature Controls — Eight-pp Catalog CC, on temperature controls and allied equipment for heating and refrigeration, provides information on recording, indicating, non-indicating controls; thermometers; bulb installation accessories; process timers, and gas pilots. Includes prices and references to detailed literature on each type of instrument. The Partlow Corp.

138 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Installation methods are also treated. Diamond Power Specialty Corp.

139 Dew Point Control — Application Engineering Data Sheet 823–13 discusses a humidification system which controls dew point of combustion air. Dis-

CHEMICAL CLEANING HELPED BY PIPE LINE PIG

Dowell saved line replacement cost with fast combination treatment, restoring full capacity in 2½ hours!

Often, the most effective and economical way to clean lines is to use *both* chemical solvents and mechanical methods.

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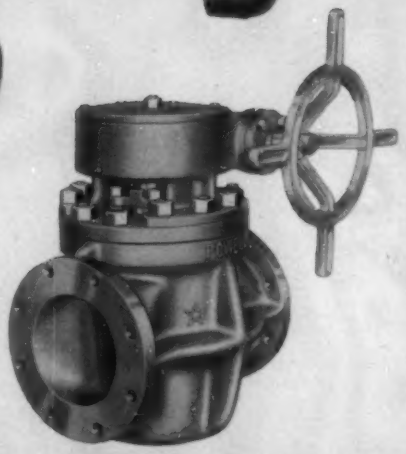
FIG. 3031 WE—Steel O.S. & Y. Globe Valve For 300 Pounds W.S.P.

FIG. 11303—1500-Pound Pressure Seal Steel Gate Valve.

FIG. 1331-A—1500-Pound Steel Integral Bonnet Offset Globe Valve.

FIG. 3059-G—300-Pound Steel Lubricated Plug Valve. Gear Operated.



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. . . *because they know Powell Valves are dependable and economical.* Power engineers also know that Powell has *the COMPLETE quality line of valves.*

Investigate the many outstanding features of the Powell Valves shown here . . . as well as *the complete line* of quality valves that have a proven record of long life and dependable service.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have.

The Wm. Powell Company, Cincinnati 22, Ohio ..... 109th year

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cusses the sampling system, Dewcel element and controller. Explains advantage afforded in slowing the formation rate of fireside deposits on the boiler tubes of stoker-fired furnaces. The Foxboro Co.

140 Automatic Proportioning System — A proportioning system that permits remote dialing of individual ingredient weights is pictured and described in 28-pp Bulletin 0351. Besides explaining how company's Select-O-Weigh system works, bulletin details installations in remote proportioning of oil shale, cement formulating, blending of feeds, net weighing with automatic tare compensation, differential weighing, other operations. Photos and engineering drawings illustrate installations. Richardson Scale Co.

WATER TREATMENT

141 Flotation Unit — Bulletin WC-119 describes company's Aeroflotor — a newly designed flotation unit. Discusses principles behind the design of the unit, its operation and special features. A schematic drawing illustrates construction and operation. Graver Water Conditioning Co.

142 For Economical Deaeration — Eight-pp Bulletin 1300 introduces manufacturer's "03", a deaerator designed to offer effective deaeration at a budget price. Explains reasons for deaeration of boiler water and tells how the "03" pays for itself in preventing boiler corrosion, providing added safety and other benefits. Discusses design and operation of these deaerators, lists 10 major advantages. Fred H. Schaub Engineering Co.

COAL, ASH HANDLING

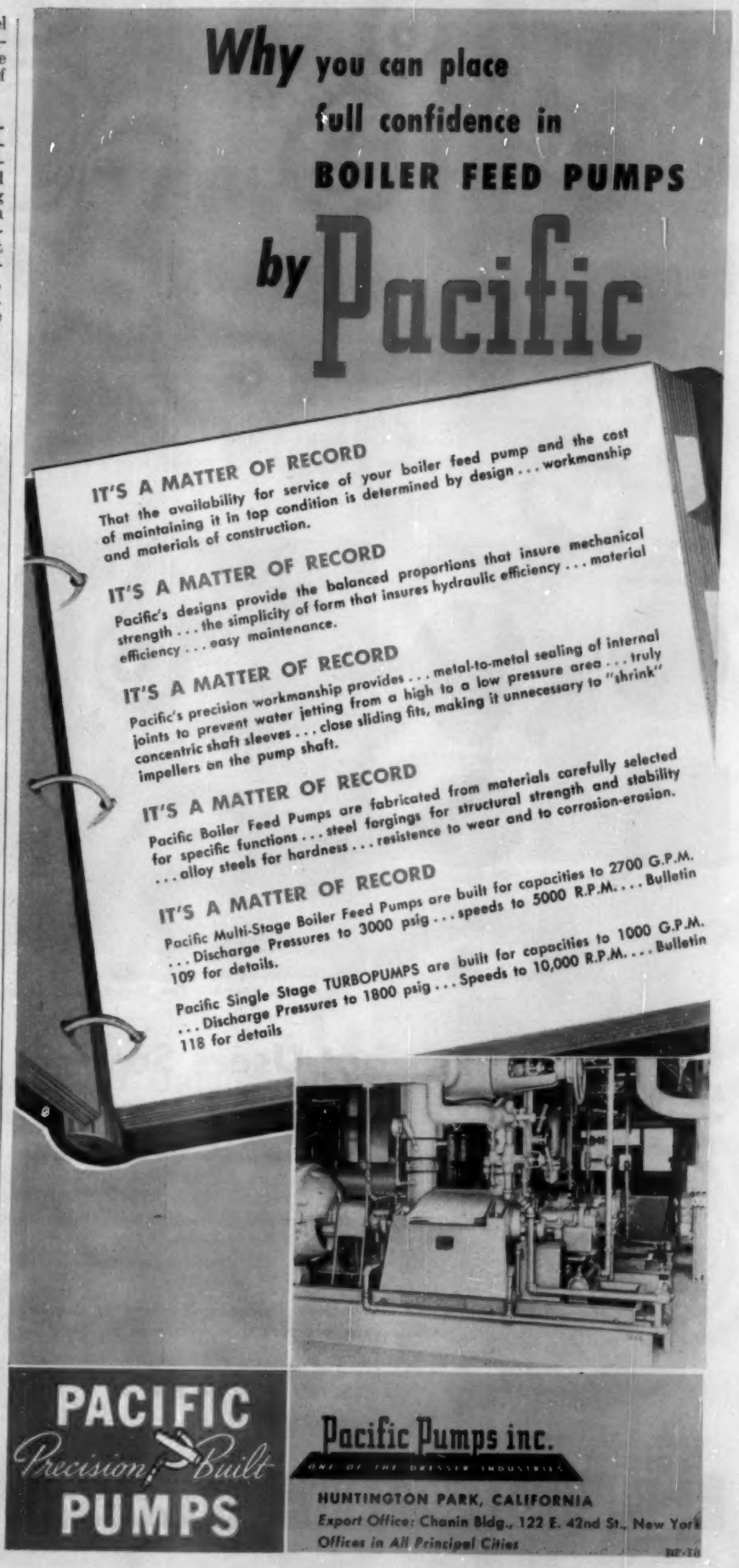
143 On Underfeed Stokers — Bulletin SB53, 12-pp, describes company's Fluid Ram and gear drive single retort underfeed stokers. Illustrates important construction and design features through a cutaway drawing and discusses two control systems available for use with the stokers. Defines company's policy in regard to servicing and supply of parts. Erie City Iron Works.

144 Fly Ash Collection — Bulletin FA presents new research data on fly ash collection and points out high efficiencies possible through use of company's electrical precipitators. Describes operation of the precipitators, new developments in design. Research Cottrell, Inc.

ELECTRICAL EQUIPMENT

145 Distribution Transformers — How company's protected distribution transformers help the utility is told in this 8-pp illustrated bulletin. Operating advantages of the transformer, available in ratings of 3 kva through 100 kva, 2400 to 14,400 v, and mechanical data on the five type designations are also given, along with a typical load-time curve for one of the units. Allis-Chalmers Mfg. Co.

147 Enclosed Conductor Systems — Catalog 8-54, 28 pp, describes Insul-8-Bar enclosed conductor systems designed for the safe electrification of cranes and monorails. Explains principles of these insulated systems, and shows why they meet requirements without need for special engineering. Contains an illustrated parts list, engineering data, selection and installation Insul-8-Corp.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That the availability for service of your boiler feed pump and the cost of maintaining it in top condition is determined by design . . . workmanship and materials of construction.
IT'S A MATTER OF RECORD
Pacific's designs provide the balanced proportions that insure mechanical strength . . . the simplicity of form that insures hydraulic efficiency . . . material efficiency . . . easy maintenance.
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Pacific Boiler Feed Pumps are fabricated from materials carefully selected for specific functions . . . steel forgings for structural strength and stability . . . alloy steels for hardness . . . resistence to wear and to corrosion-erosion.
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Pacific Multi-Stage Boiler Feed Pumps are built for capacities to 2700 G.P.M. . . . Discharge Pressures to 3000 psig . . . speeds to 5000 R.P.M. . . . Bulletin 109 for details.
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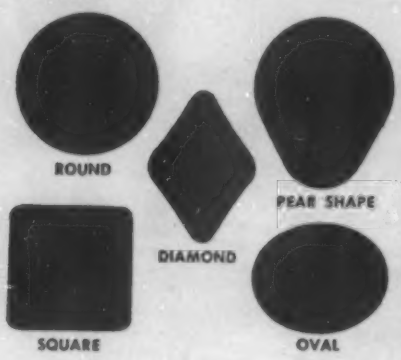
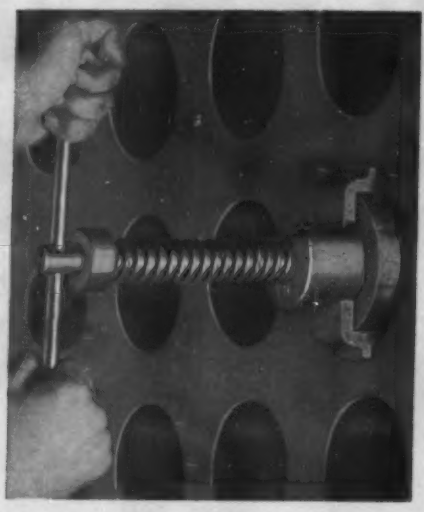
Eliminates Dirty, Tedious Work

Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.

These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.





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Roto Hand-hole Seat Scraper for B & W Boiler.

What Users Say—

It did a fine job. Completed the work in 80% less time.
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One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days.
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148 Aluminum Bus Conductors — The availability, properties, advantages and methods of joining and bending aluminum electrical bus conductors are detailed in this 12-pp bulletin. Prepared to assist power engineers in converting to aluminum bus — bulletin covers rectangular bar, tubular conductor and solid round bar. Contains information on thermal, electrical and physical properties, dimensions, weights and tolerances for a large range of shapes, alloys and sizes. Describes proper methods for joining. Kaiser Aluminum & Chemical Corp.

Postage-free cards for ordering catalogs are on pages 119-120. You may also use the cards to ask for further information on the advertised products.

149 Motor Control Data — This little pocket-size booklet (5411) on electric motor controls contains 46 pp of photos, specifications and prices. It is designed as a handy reference for magnetic starters and contactors, push buttons, combination starters, drum controllers, and switches. Includes heater coil selection tables for standard and slow type overload relays. Furnas Electric Co.

150 Battery Manual — Battery selection techniques are emphasized in 20-pp Bulletin 210, a revised edition of this manufacturer's manual on storage batteries for stand-by power, emergency lighting and switchgear applications. A discussion of charging equipment and simplified battery maintenance procedures is included. Storage battery installation procedures are described and illustrated by photos. Exide Industrial Div., The Electric Storage Battery Co.

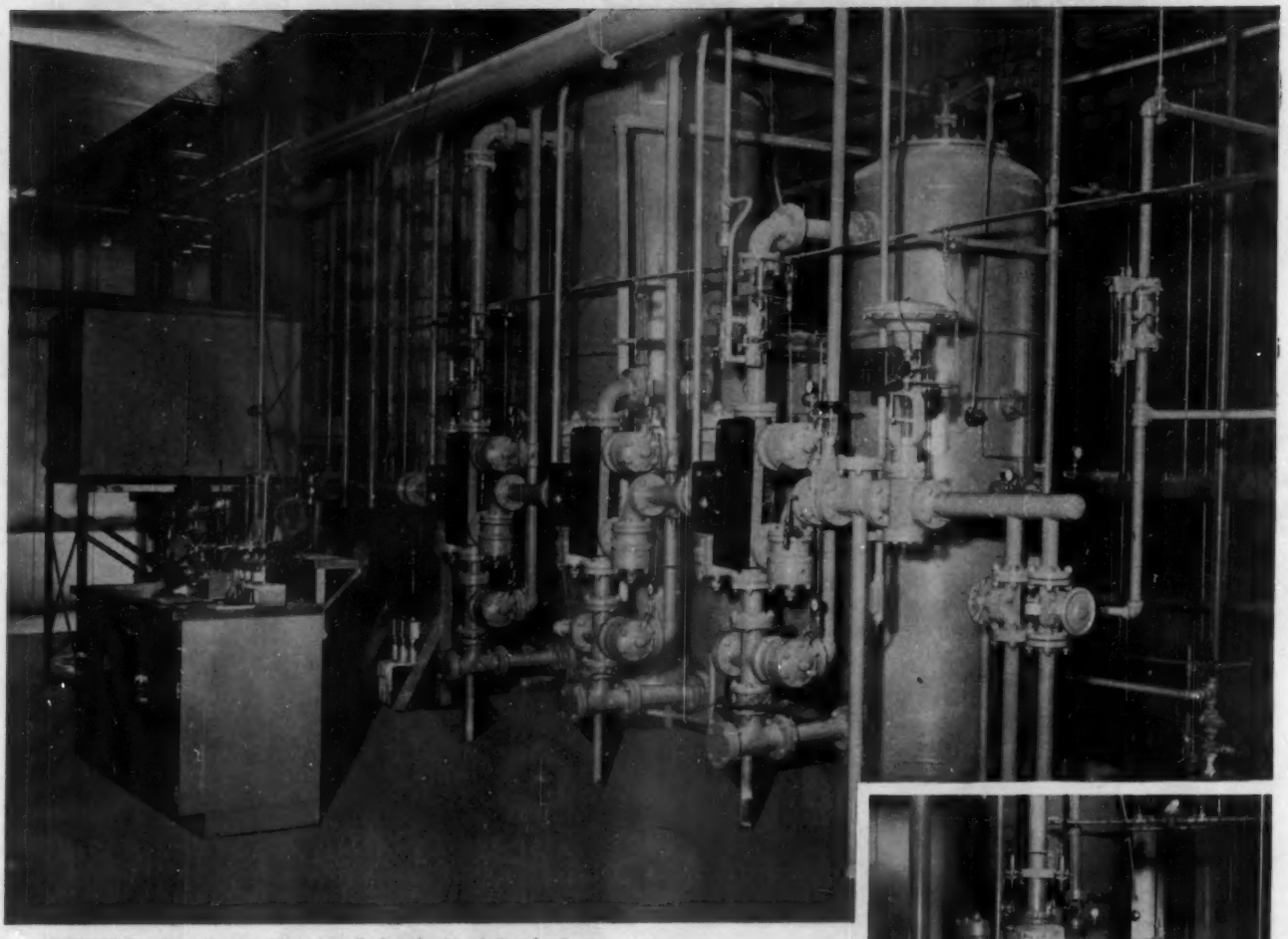
151 Single-Phase Meter — Ten-pp. Booklet CP-1025 uses a three-dimensional representation of company's single-phase Lifetime meter to explain new features of design and construction. A system of flexible transparent overlays represents five cross-sectional views. By superimposing these overlays upon basic view, it is possible to "assemble" meter as effectively as on assembly bench. In addition, it explains chief design factors. Westinghouse Electric Corp.

152 Finding Fault Grounds — This 32-pp illustrated booklet covers use of the Allen ground detector in the detection and location of electrical fault grounds. Separate chapters cover grounded vs ungrounded systems, operating instructions, explanation of misreadings encountered, complete cancellation, detection of fault grounds in lead-covered underground cable, tracing buried and/or hidden elements. Excel Electric Service Co., Inc.

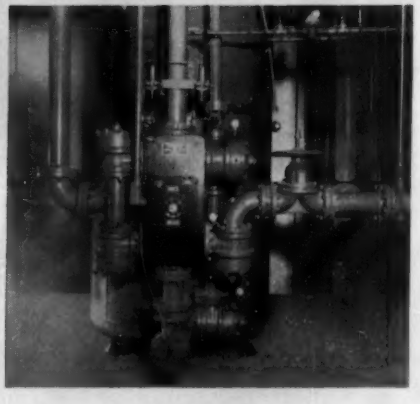
FURNACES, REFRACTORIES

153 Furnace Construction — This 20-pp illustrated catalog features company's unit suspended walls and arches for industrial furnaces, emphasizing latest advancements made in "balanced design." Describes various types of standard construction, and contains cutaway views illustrating general details of these constructions. A technical data chart is included. Bigelow-Liptak Corp.

INFILCO improved demineralization reduces feedwater costs 35%!



INFILCO Demineralization Plant installed at the North Omaha Station.



Close-up of "CATEXER" ion exchange unit.

Here's how it was done at Omaha –

Omaha Public Power District's source of feedwater make-up for 1500 p.s.i. boilers is the Missouri River. This water has high and extremely variable mineral content. Their previous experiences with two-bed demineralization plants indicated that the average chemical cost per 1,000 gallons of treated water would be approximately 40¢.

In considering the water treating requirements of the new North Omaha Station, INFILCO Engineers suggested a new type, four-bed demineralization plant. This suggestion was accepted and actual operations have shown the chemical costs have averaged 26¢ per 1,000 gallons—a saving of 14¢ over the original estimates. In addition, this *fully-automatic* plant initiates regeneration when required, regardless of variations in raw water mineral content, without sacrificing treated water quality.

If you have a high pressure boiler feedwater problem, CATEXER® ANEXER® Demineralization Plants are sure to offer an economical solution. Write for information or see your Consulting Engineer.

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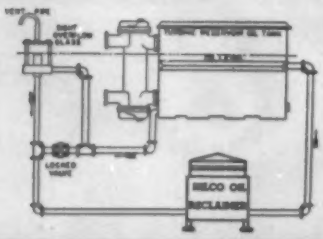
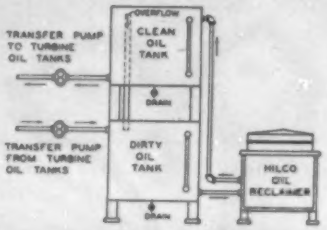
TURBINE OIL CONDITIONING...

OIL RECLAIMER

The HILCO Turbine Oil Reclaimer is a self-contained, compact unit that will produce and maintain oil free of all solids, sludge, acids, moisture and air, keeping the oil in first class condition. Its purifying process is a continuous, all electric, automatic operation, requiring infrequent attention. It removes contaminants as fast as they are formed, maintaining lubricating oil at full value of new oil. HILCO Oil Reclaimers will also purify compressor, hydraulic, insulating, Diesel and gas engine lube oils.

Purifies Turbine Oil by Continuous or Batch Purification . . .





A continuous, direct-connected, foolproof oil reclaiming system. Oil flows from turbine reservoir tank to sight overflow glass, to HILCO Oil Reclaimer, and back to reservoir.

A batch system designed to serve one or more turbines when it is desired to withdraw all the oil from reservoir for complete periodic batch reclaiming to restore all oil as good as new.

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154 Boiler Refractories — Twenty-pp Bulletin R-36 is offered as an authoritative guide for selecting most efficient and economical refractories for boilers. Discusses importance of proper refractory materials and basic requirements they must meet to avoid chief causes of refractory failure. Typical uses of firebrick, insulating firebrick, castables, plastics and mortars, in both refractory-lined and water-cooled boilers, are described and pictured. Refractories Div., The Babcock & Wilcox Co.

155 Modernizing Boiler Settings — Bulletin 954 tells how horsepower capacity can be increased through modernization of boiler settings. Charts illustrating test results after boiler rejuvenation are produced and installation photos are included. Geo. P. Reintjes Co.

OTHER EQUIPMENT

157 Why Induced Draft Towers — Answers to 15 questions concerning this manufacturer's induced draft cooling towers are detailed in handsomely illustrated Bulletin 4.9.080, about 30 pp. Answers cover advantages of this type of tower, materials of construction, fabrication, structural features, mechanical equipment utilized, erection service, typical installations, sizes available. J. F. Pritchard & Co.

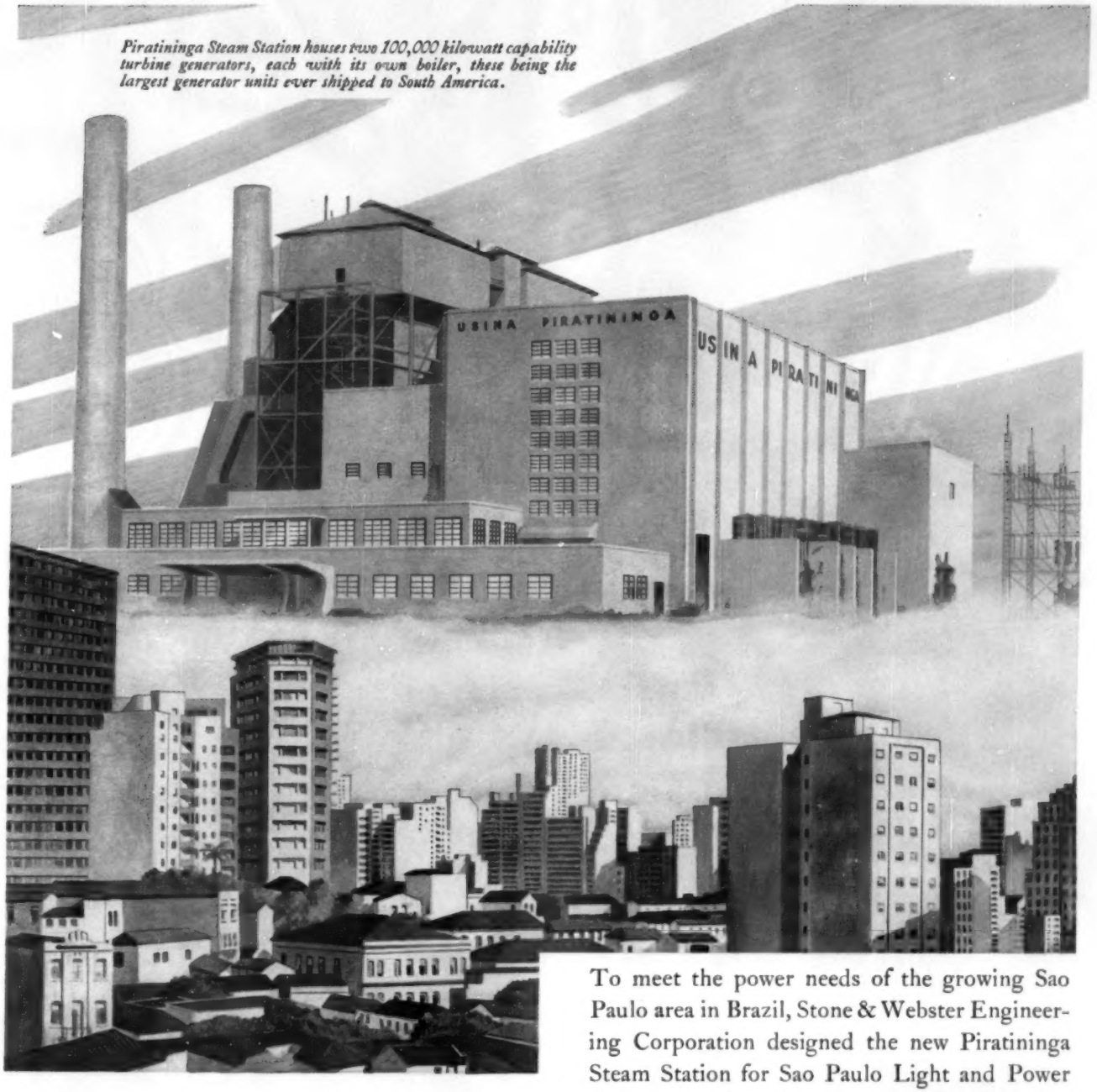
158 Utility Blowers — Dimensions, specifications, and performance data on non-overloading utility blowers with backward curved blades are presented in concise form in 48-pp Bulletin BC-11. Covers belt-drive and direct-drive models. Also company's Arrangement 2 utility blowers, and Arrangement 3 blowers. Hartzell Propeller Fan Co.

159 Data on Cast Iron — Bulletin A-71, 64-pp, features applications of Ni-Resist, corrosion resistant nickel alloyed cast iron, in nine specific industries as well as in general industrial uses. Booklet tabulates mechanical and physical properties offered by the eight types of Ni-Resist. Section on corrosion data shows superiority of this material under various industrial conditions. Problem data sheets are included for submitting heat, corrosion, or controlled expansion problems. The International Nickel Co., Inc.

160 Steam Condensers — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

161 O-Rings for Sealing, Gasketing — Catalog AD-148, 20 pp, describes company's O-rings for sealing and static gasketing. Gives design information, recommended pressures, and available materials for both dynamic and static applications. Also lists standard O-ring sizes. The Garlock Packing Co.

162 Slide Rule Ordering Guide — Application and ordering information on metal slide rules is provided in illustrated Catalog 164-A, 32 pp. Rules shown range from simple basic units through standard scale arrangements to an advanced dual-base log log vector hyperbolic model. Also presented in the catalog are slide rules for special applications, slide rule instruction books. Pickett & Eckel, Inc.



Piratininga Steam Station houses two 100,000 kilowatt capability turbine generators, each with its own boiler, these being the largest generator units ever shipped to South America.

ACHIEVEMENT IN BRAZIL . . .

To meet the power needs of the growing Sao Paulo area in Brazil, Stone & Webster Engineering Corporation designed the new Piratininga Steam Station for Sao Paulo Light and Power Company, Limited, an operating subsidiary of the Canadian corporation, Brazilian Traction, Light & Power Company, Limited. Construction for the first unit, now in operation, was completed in a record time of 26 months by Stone & Webster Construction Company.

All available materials were purchased in Brazil, and the field forces, totaling over 1800 at the peak of construction, were recruited locally.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

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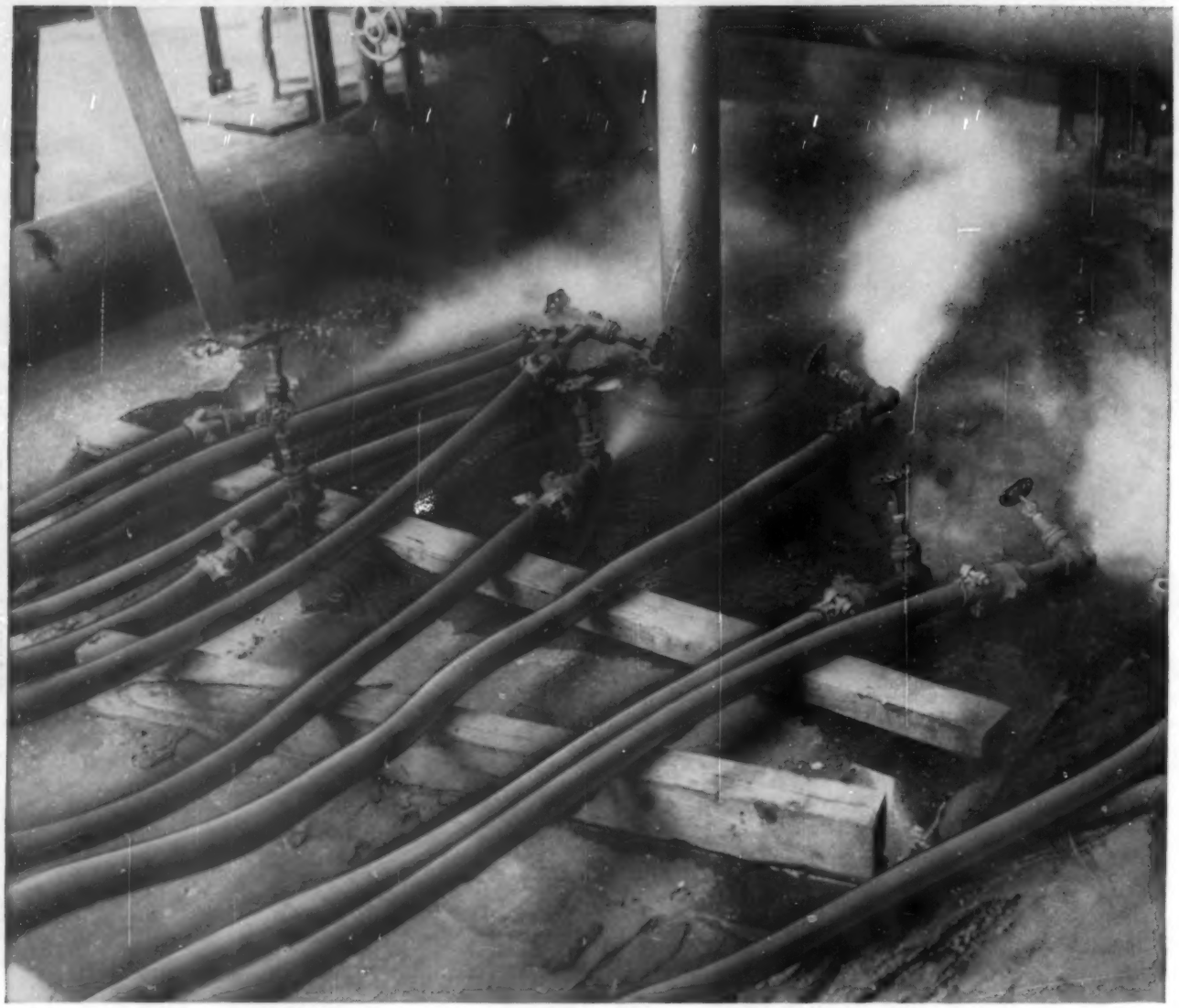

For Real Insurance Against Danger of Bursting Hose

For general steam service Ironsides-Victor is widely accepted as the strongest, safest hose available. Its superiority is due to its construction.

Ironsides-Victor is braided with steel wire, bonded with rubber, and has an extra braid of glass cord for insulation and added strength. There is absolutely no cotton used in this hose. The tube is of a special compound that resists very high temperatures — even up to 388° F.

Because of its extra-tough, extra-thin wall construction, this hose is lighter, more flexible, and easier to handle than any other steam hose . . . and it's kink-proof.

Ironsides-Victor is at least four times stronger than wrapped fabric steam hose, yet costs no more. For safe, efficient, economical service—specify Ironsides.

Available in I.D. sizes ½" to 2½", in 25 and 50-ft. lengths, with interlocking, high pressure type couplings.

We also manufacture a complete line of industrial rubber products: hose, belting, packing and moulded rubber of every construction for every need. *Through your Quaker and Quaker Pioneer distributor* our research and engineering services are always available to help you solve any industrial rubber problem. *Write for free folder and name of nearest distributor.*

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San Francisco 7, California

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Let's take a NEW LOOK at spreader stoker firing

particularly

DETROIT ROTOGRATE

stoker advantages

One of five Detroit RotoGrate Stokers assembled before shipment to a mid-west public utility.

Detroit RotoGrate Stoker with two of the six Rotors removed to show the overlapping highly restricted grate designed especially for spreader stoker firing.

- **High Burning Rates** per square foot of grate area permit continuous operation with less expensive boiler and furnace design
- **Low Carbon Loss** results in high over-all efficiency
- **Superior Design** permits operation with low excess air
- **Wide Load Range** handled smokelessly with convertible grate area
- **Low Maintenance** compared to other coal-burning methods.
- **Burns All** bituminous coals and Lignite. Also bark, wood, bagasse and other refuse fuels, either separately or in combination with coal

• Contact our nearest District Office or your consulting engineer.

Backed by over a half century of experience.
Complete manufacturing and service facilities.

DETROIT STOKER COMPANY

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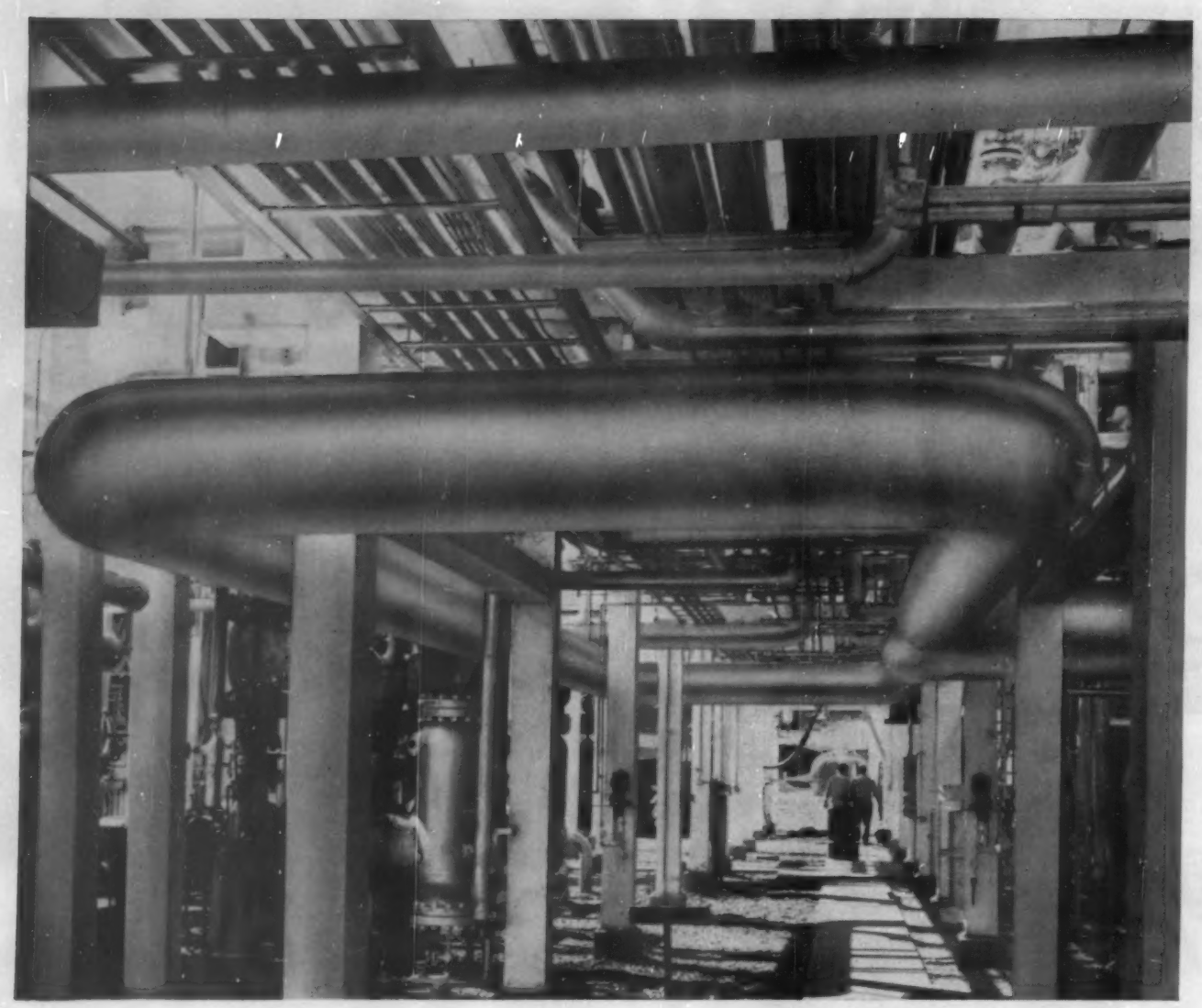

Less heat loss at joints with single-layer Unibestos® Pipe Insulation

Tests prove that Unibestos single-layer pipe insulation actually provides greater protection than other nonfibrous *double-layer* insulations which cost more to install. Unibestos is made of Amosite—the long-fibered African asbestos. These fibers interlock with one another to prevent heat loss at horizontal and longitudinal joints.

While most insulating materials show a pronounced shrinkage at high temperatures, Unibestos has no measurable shrinkage at 1200°F. It will not powder, pulp or wash off, even under heavy moisture conditions, and when dry, Unibestos resumes its original thermal and physical characteristics.

EASY to install. . . easy to remove.

Unibestos can be cut, mitered and handled easily. The fabrication of insulation for tees, valves, flange covers, etc., is a fast, low-cost operation. Because of its unusual strength and durability Unibestos can be removed and replaced with little or no loss of material.

STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

For complete information, write for descriptive Bulletin 109C

UNARCO

UNION ASBESTOS & RUBBER COMPANY

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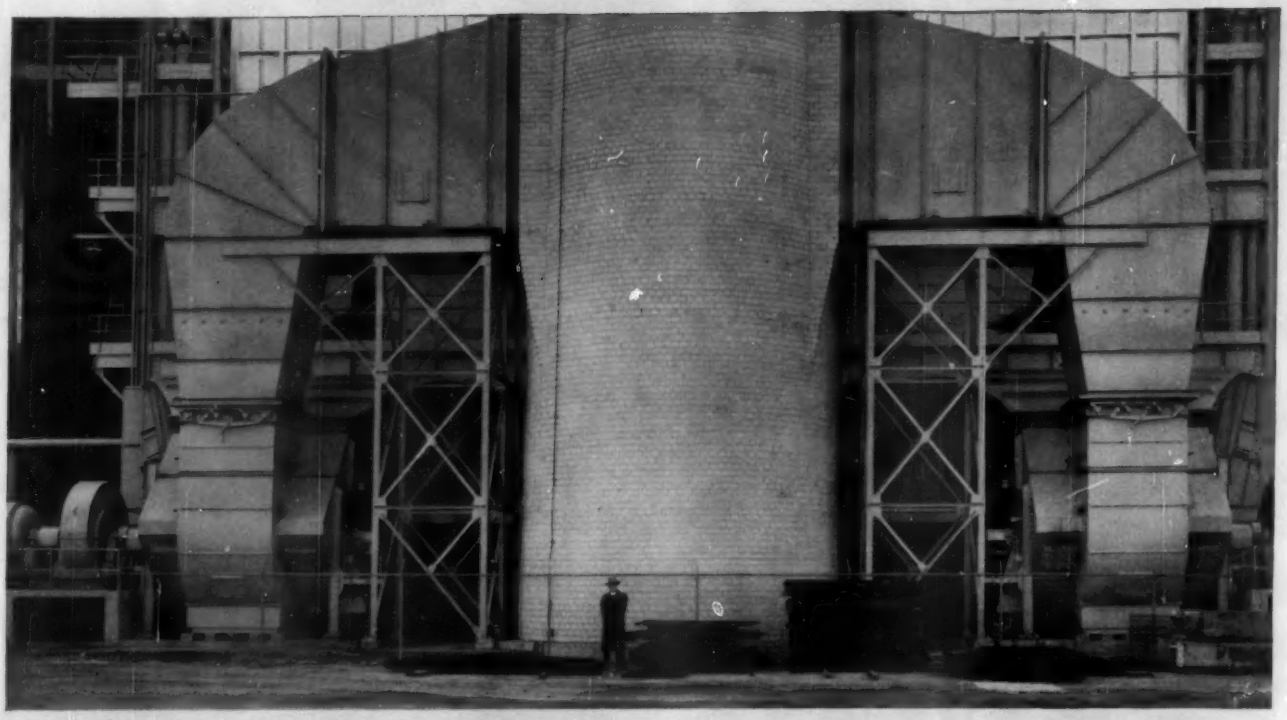


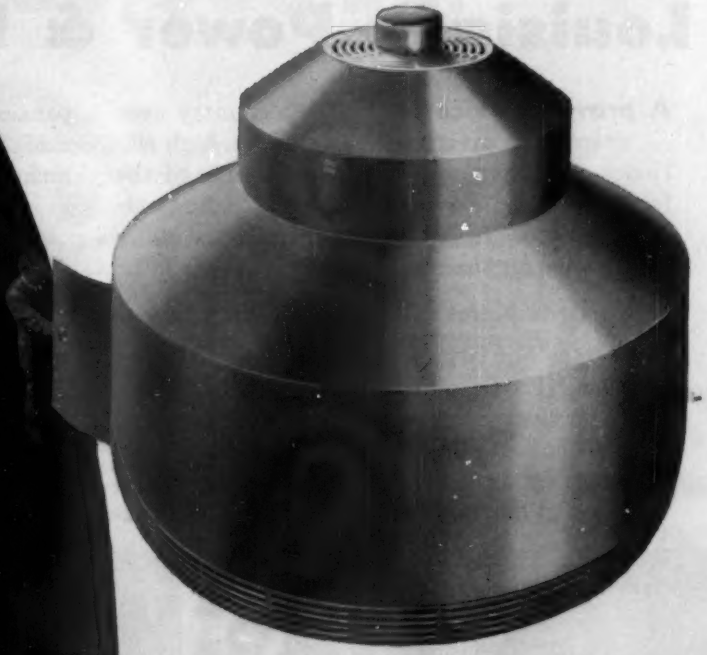
SHEET and PLATE FABRICATION for POWER PLANTS

● breechings ● air & gas ducts ● stacks ● casings ● bins and hoppers
● louvers ● exhaust piping ● insulation jacketing ● control panels and desks

WHATEVER YOUR REQUIREMENTS IN SHEET AND PLATE FABRICATION...CALL ON **KIRK AND BLUM**

The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for more than 47 years. Exceptional experience and complete facilities up to ½" in carbon steel, stainless, aluminum, monel and other alloys.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog.



THE KIRK AND BLUM MANUFACTURING CO. 3230 FORRER STREET, CINCINNATI 9, OHIO

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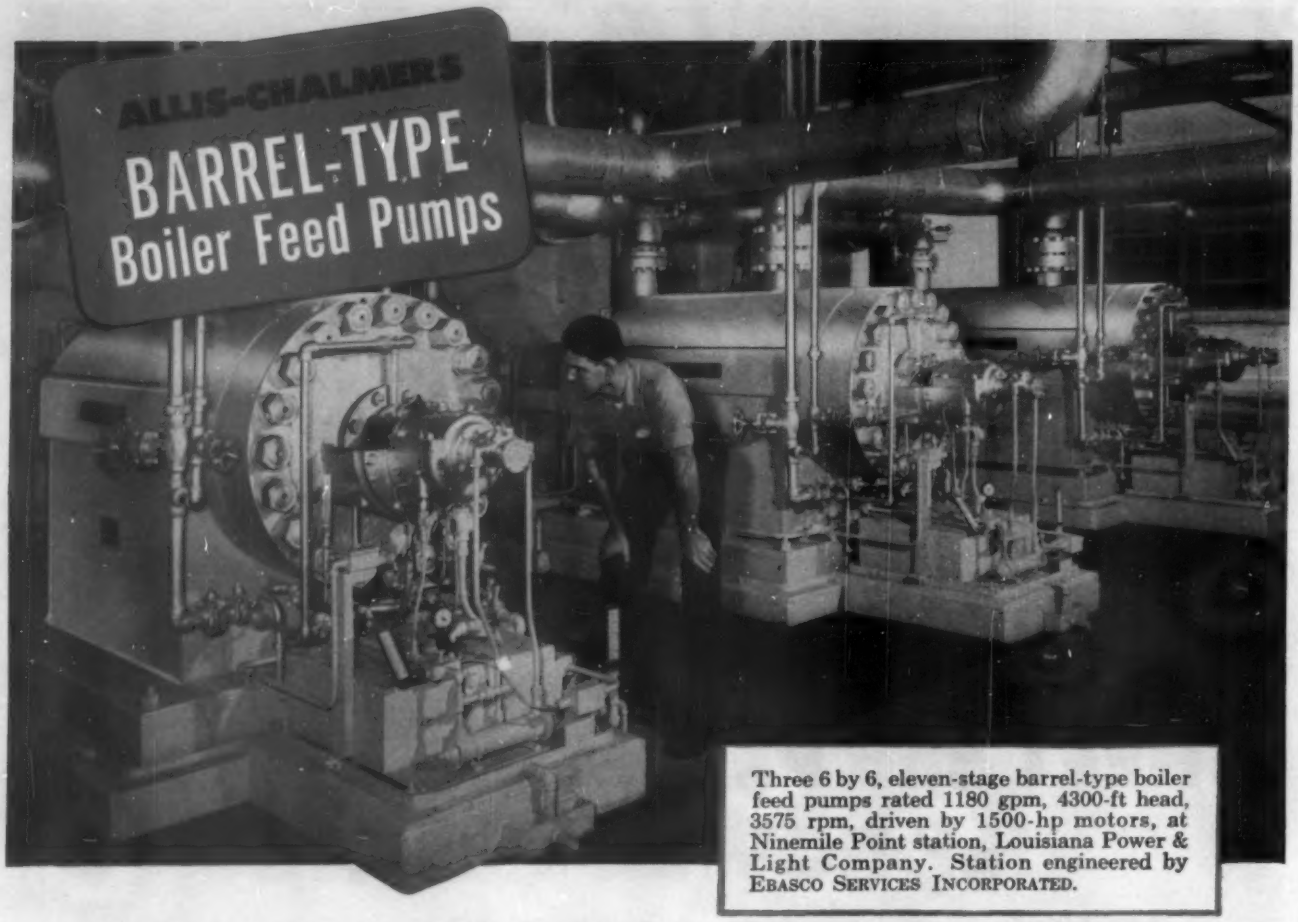

Three 6 by 6, eleven-stage barrel-type boiler feed pumps rated 1180 gpm, 4300-ft head, 3575 rpm, driven by 1500-hp motors, at Ninemile Point station, Louisiana Power & Light Company. Station engineered by EBASCO SERVICES INCORPORATED.

First Choice with Louisiana Power & Light Company

A proved service record the country over . . . simple, low maintenance design . . . high efficiency performance — these were some of the factors that led Louisiana Power & Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their Ninemile Point station.

Features Keep Operating Costs Low

First stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers, mounted back to back, balance axial forces without use of balancing drum. Double volute casing maintains radial balance under fluctuating load. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

Complete Unit From One Source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 08B7899.

A-4635

ALLIS-CHALMERS

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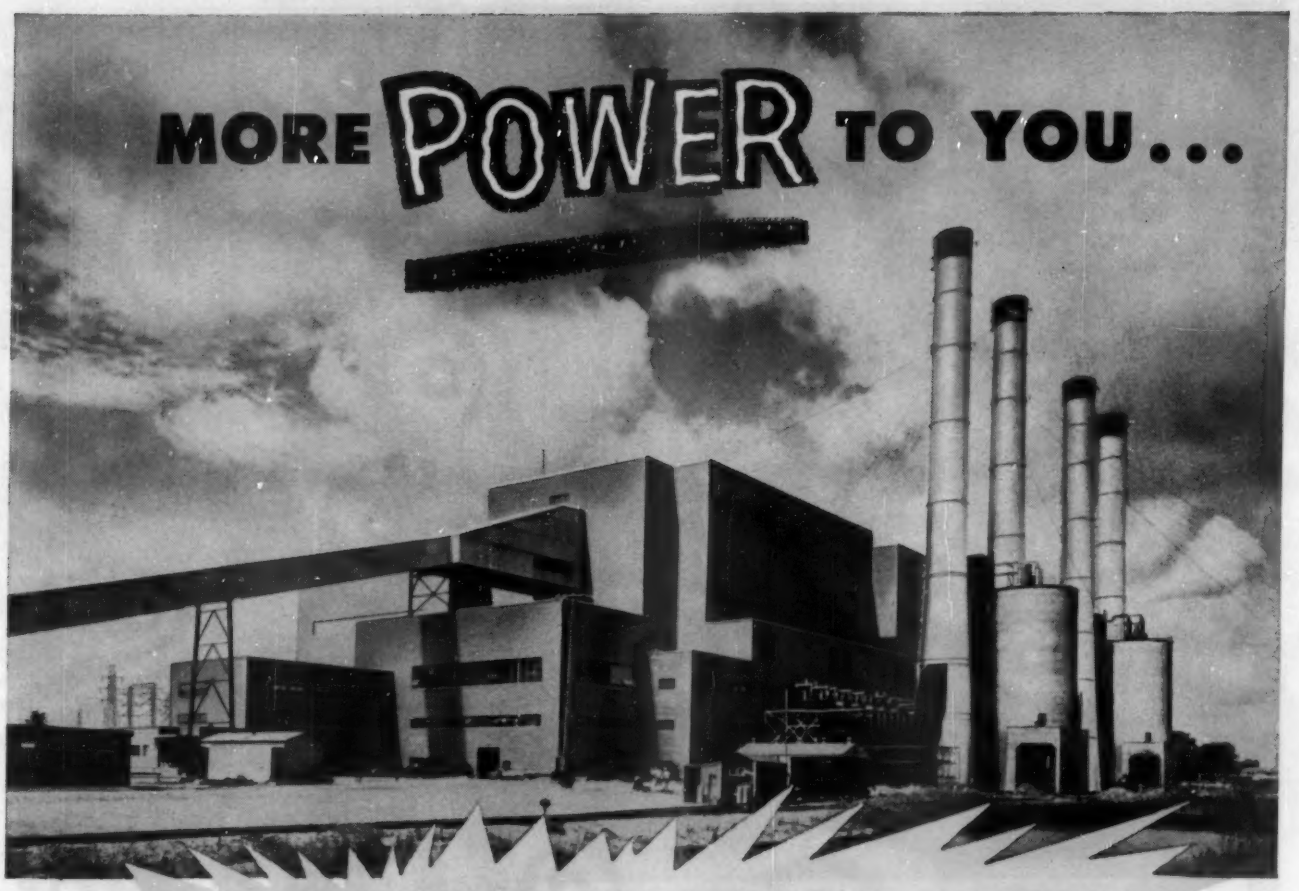

Detroit Edison Plant boosts U.S. Electrical Capacity to 100,000,000 KW.

Detroit Edison's St. Clair plant boosts U. S. generating capacity to a new high. The latest St. Clair unit, rated at 156,250 kw., to go on the line brought the total U. S. electrical capacity to over 100 million kw. Shell Turbo Oil 27 was purchased as the lubricant for this unit as well as for the other three turbine generators in this plant.

Shell Oil Company extends heartiest congratulations to Detroit Edison Company for their part in achieving this industry milestone in electrical power.

Shell is proud of its long association with the great electrical industry.

SHELL OIL COMPANY

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SHELL

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Tube sheets at 4-spindle automatic drill in Braun shop.

Two fine names that work together

Braun comes to Revere for plates

C. F. Braun & Co., Alhambra, Calif. is well known in the petroleum industry, the chemical industry, and other businesses in which heat transfer and fractionation are vital. Revere Copper and Brass Incorporated is well known in the non-ferrous metal industry for its tube sheets and plates, in all the customary alloys. What is more natural than the close relations between the two companies, Revere the supplier, Braun the fabricator? Revere can furnish heavy plates when needed; Braun is one of the great heavy-duty shops of the country. So far as transportation limits permit, Braun fabricates in its own plant; their machines and their cranes can handle anything the railroads can haul away. The same is true of Revere, which is likewise known throughout heavy industry for its ability to produce not only large plates, but also condenser and heat exchanger tubes.

Revere is pleased to be an important supplier to Braun. Remember, good names find it good business to come together. The next time you want quotations on tube sheets and plates, and condenser tubes, get in touch with the nearest Revere Sales Office.

A Braun engineer inspects a drilled tube sheet.

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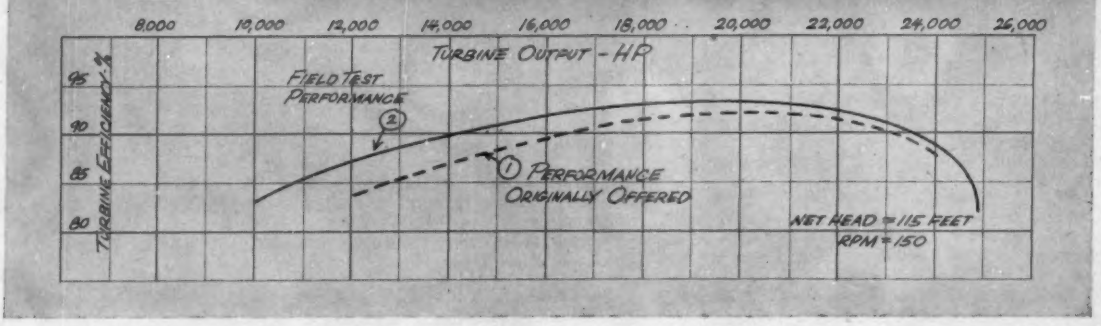
Two SMS-Francis turbines at Tenkiller Ferry Dam on the Illinois River in Oklahoma are rated at 23,000 hp each under 132 feet net head.

SMS
FRANCIS TURBINES



FIELD TESTS EXCEED PROPOSED PERFORMANCE AT TENKILLER FERRY DAM

Existing designs at the time of the proposal enabled SMS to offer the performance shown on Curve 1 (above) for the Tenkiller turbines which are of only medium size. Subsequent homologous model tests required by the Corps of Engineers led to improvements which were incorporated in the final design. These resulted in the performance shown by Curve 2, plotted from actual field tests made at 115 feet net head. Actual efficiency exceeded the initially proposed performance at all loads.

This illustrates that the outstanding performance of SMS products results from laboratory research as well as from specialized engineering and production. For information on SMS turbines and related hydraulic equipment, write to the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
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CONSTRUCTION NEWS

Sitka, Alaska — Alaska Lumber & Pulp Co., Sitka, plans power house in connection with new wood pulp mill in that vicinity. Project will comprise a large group of buildings and is reported to cost close to $40,000,000. H. Cavin, Bellingham, Wash., is consulting engineer.

Eureka, Calif. — Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., has plans maturing for new steam-electric generating plant at Buhne Point, near Eureka, where tract of over 148 acres of land has been selected. It will have a rated capacity of 50,000-kw., and is estimated to cost over $9,000,000. Capacity noted will be increased with other generating units at later date.

Fresno, Calif. — Southern California Edison Co., 601 West Fifth St., Los Angeles, Calif., will begin work in near future on Mammouth Pool Project on San Joaquin River, Fresno County, about 36 mi. from Fresno. Work will include a power dam, 315 ft. high, 123,000 acre-ft. capacity reservoir, and tunnel about 40,000 ft. long. Hydroelectric power plant will be equipped for an initial capacity of 126,000-kw. Project will require about 36 mos. for completion and is estimated to cost $44,500,000.

Los Angeles, Calif. — Southern California Edison Co., 601 Fifth St., will expend about $76,000,000 for expansion and improvements in steam-electric generating plants during present year. This includes new steam-electric station at El Segundo, Calif., now under way, which will have a rated capacity of 320,000-kw., and new Alamitos steam-electric plant near Long Beach, Calif., on which work has just begun, both projects previously noted in these columns. Other work will include extensions in transmission lines, power substations and auxiliary operating facilities.

Oakdale, Calif. — Oakdale and South San Joaquin Irrigation Districts, 322 East D St., Oakdale, has plans maturing for initial work on Tri-Dam tunnel and power project on Stanislaus River, Tuolumne and Calaveras Counties, Central Calif. Immediate project will include two dams, known as Donnells and Beardsley Dams, respectively, with hydroelectric generating stations, for which details and capacities will be determined soon. Entire project will cost close to $50,000,000. B. G. Goodenough, 100 Bush St., San Francisco, Calif., is consulting engineer.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., estimates an expenditure of $270,000,000 during 1955–56, for new steam-operated and hydroelectric generating plants, expansion in present generating stations, switching stations, power substations, transmission lines and other operating facilities.

Miami, Fla. — Florida Power & Light Co., Miami, has authorized an appropriation of $41,300,000, for extensions and improvements in power plants and system in 1955. Work will include two generating plants in southern part of state, each with capacity of 140,000-kw., on which work is scheduled to begin this year, with completion in 1956 and 1957, respectively. Work is in progress on addition to steam-electric generating station at Palatka, Fla., to cost over $1,500,000, previously reported in these columns, and scheduled for completion in 1956.

Chicago, Ill. — Commonwealth Edison Co., 72 West Adams St., has arranged a construction budget of about $125,000,000 for 1955, including expansion in generating facilities, transmission and distributing lines, power substations and other facilities. Company expects to expend $90,000,000 additional in 1956, $105,000,000 in 1957, and $100,000,000 in 1958. At the end of that time generating capacity will be advanced from 3,422,000-kw. to 4,272,000-kw.

Wichita, Kan. — Kansas Gas & Electric Co., 215 North Market St., is arranging a fund of about $30,000,000 for expansion and improvements in power plants and system during 1955, including increased generating capacity, power substations, transmission lines and other operating facilities.

Jackson, Mich. — Consumers Power Co. has authorized a construction budget of $70,000,000 in 1955, for extensions and improvements in generating plants, power substations, transmission lines and other operating facilities. Company proposes to increase generating capacity by 468,750-kw. during year, including work now in progress at the John C. Weadock steam-electric station at Saginaw Bay, previously noted in these columns.

St. Louis, Mo. — Union Electric Co. of Missouri, 315 North 12th Blvd., has authorized expansion at Meramec steam-electric generating plant near city, with work to comprise a new section to station, and installation of turbine generator, with capacity of 200,000-kw., high-pressure boilers and auxiliary equipment. Entire project is reported to cost in excess of $30,000,000, including extensions in transmission lines, power substations and other operating facilities.

Atlantic City, N. J. — Atlantic City Electric Co., Kentucky Ave., has arranged a construction budget for 1955, to cost about $12,600,000. The work will include additional generating facilities, transmission lines, power substations and other operating units.

Buffalo, N. Y. — Niagara Mohawk Power Corp., 535 Washington St., is considering plans for expansion in local steam-electric power plant, with installation of new 200,000-kw. generating unit, high-pressure boilers and auxiliary equipment. Entire program reported to cost over $25,000,000, with transmission lines, power substations and other operating facilities.

Rochester, N. Y. — Rochester Gas & Electric Corp., 89 East Ave., plans an expenditure of $37,500,000 during next 24 mos., 1955–56, including extensions and improvements in power plants, transmission lines, power substations and other facilities. Increase in present generating capacity will be carried out.

Raleigh, N. C. — Carolina Power & Light Co., 336 Fayetteville St., has authorized an expenditure of about $45,000,000 during present year for expansion and improvements in power plants and system, including increased generating capacity, power substations, transmission lines and other operating facilities.

Columbia, S. C. — South Carolina Electric & Gas Co., 328 Main St., has arranged financing through sale of stock, totaling about $3,800,000, proceeds to be used for extensions and improvements in generating plants, transmission lines, power substations and other operating facilities. This will be part of 1955 construction program of company.

Dallas, Tex. — Dallas Power & Light Co., 1506 Commerce St., has authorized a fund of about $20,000,000 for expansion and improvements in plants and system during 1955, including increased generating facilities, power substation, transmission lines and other work.

Fort Worth, Tex. — Texas Electric Service Co., Seventh St., has arranged financing through sale of bonds in amount of $17,000,000, proceeds to be used for extensions and improvements in generating plants, power substations, transmission lines and other operating facilities.

Ephrata, Wash. — Grant County Public Utility District No. 2, Ephrata, will make application soon to Federal Power Commission, Washington, D. C., for permission to construct a power dam at Priest Rapids on Columbia River, and installation of hydroelectric generating station. Studies are now in progress for estimated plant capacity and other details of project, with estimates of cost. It will represent an investment of more than $20,000,000.

Olympia, Wash. — Washington State Power Commission, Olympia, J. Frank Ward, managing director, is projecting plans for two State-owned steam-electric power plants on sites to be selected at early date. Each plant will have a rated capacity of 150,000-kw. Project is estimated to cost about $45,000,000, including station construction, turbine-generators, high-pressure boilers and auxiliary equipment, as well as transmission lines, power substations and other operating facilities. Application will be made to the State Legislature for an appropriation for the amount noted.

Seattle, Wash. — Puget Sound Power & Light Co., Stuart Bldg., has scheduled a fund of $75,000,000 for expansion and improvements in power plants and system during the next 48 mos., 1955–59, including extensions in power plants, transmission lines, power substations and other operating facilities.

Alma, Wis. — Dairyland Power Corp., 123 North Fourth St., LaCrosse, Wis., is scheduling a call for bids in May for superstructure of proposed new addition to steam-electric generating plant at Alma, recently noted in these columns. Expansion is estimated to cost about $8,500,000, with turbine-generator high-pressure boiler and accessories. Vern E. Alden Co., 33 North LaSalle St., Chicago, Ill., is consulting engineer.

Madison, Wis. — Madison Gas & Electric Co., 100 North Fairchild St., plans new addition to local generating station, with installation of new turbine-generator, high-pressure boiler and accessory equipment. Entire project reported to cost close to $9,000,000.

New BETTER way to insulate plant piping

gb SNAP*ON

Less than two years ago it was a time-consuming and expensive job to insulate plant piping. Not so today, thanks to a new concept in pipe insulation — G-B Snap*On, the new one-piece molded pipe insulation of fine glass fibers.

Snap*On goes on piping far quicker and easier than any other pipe covering, with less down-time or interruption of plant processes. It comes in 6' sections that can be snapped over piping in a matter of seconds. It's exceptionally light in weight, easy to apply even in tight spots. No time is wasted in clean-up, since Snap*On is clean and dustfree, won't crumble when dry or get muddy when wet.

All this adds up to quicker, easier application than you've ever experienced. So don't fail to try Snap*On the very next time you need insulation from chilled or heated piping where temperatures do not exceed 350°. You'll find there's absolutely *nothing* like it for *economical application, thermal efficiency* and *permanence.*

FOR SAMPLE AND NEW BROCHURE, *write today or call the G-B Distributor in any of 57 cities. You'll find him listed in the Yellow Pages under "Gustin-Bacon Insulations."*

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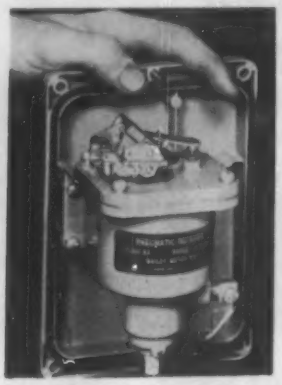
EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 119–120 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—PLUG-IN RECEIVER to standardize multiple recording

Unlimited record grouping, shelf-to-operation simplicity, and drift-free stability are claimed for this pneumatic receiver for instrument and control systems in power and process plants. Transmitted pneumatic signals of a



measured variable are received by this unit which drives a recording pen. Arbitrary mounting of one to four identical units in any of this manufacturer's receiver recorders is made possible by plug-in, pin-positioned construction and an indexed drive arm. Signals may be graphically recorded in any combination from any make of pneumatic transmitter with 3 to 15 psig or 3 to 27 psig ranges. The receiver is factory calibrated to less than ± ½ per cent of range span and sensitive to signal changes of 0.01 psi. Ambient temperature changes between 30 and 130 F are compensated by an isoelastic spring. Bailey Meter Co.

2—RESIN COATING protects many types of surfaces

Thick-Coat is announced as a product which provides a durable protective coating for new or corroded metal, concrete and wood equipment and structures or surfaces exposed to fumes, corrosive chemical laden atmospheres or spillage of corrosive chemicals of acid, alkaline or neutral nature. The coating is applied like regular maintenance paint by brush, roller or spray as it comes from the can. In a three-coat system — one primer and two top coats — it will build to a minumum of 6 mils dry film thickness. Containing over 60 per cent solids by weight, Thick-Coat is reported to give long lasting protection on edges, prominences and crevices as well as on plain surfaces. Standard colors are white, green, slate gray and black. Pennsylvania Salt Mfg. Co.

3—CABLE TROUGH has pin type couplers

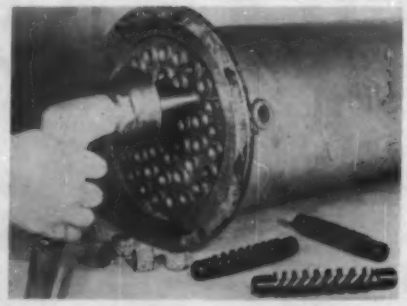
The 70,000 Series of standard cable trough is constructed with built-in pin type couplers which permit sections to be joined in a matter of seconds. It will be sold in lengths of 8, 10, and 12 ft. Estimates indicate that savings in field assembly time from 70 to 80 per cent are possible, manufacturer points out. All fittings such as tees, elbows, risers, are also equipped with the pin type couplers for quick assembly. Bulletin 67A gives data. T. J. Cope, Inc.

4—YARN PACKING for high peripheral speeds

This Teflon yarn packing is designed to function at higher peripheral speeds than braided tape or molded forms of Teflon. The anti-frictional properties of Teflon combined with the softness, resilience and fluid retention of fibre construction enables the packing to run substantially cooler than other types, manufacturer notes. The packing affords the anti-corrosive, thermal, mechanical and other inherent advantages of Teflon, and it is tightly braided to provide density and firmness and to eliminate large voids. Where some type of lubricant is required the packing can be impregnated with fluorolube or other satisfactory lubricating material. It is suggested for rugged and corrosive service on pump shafts and valve stems. Available sizes are ⅛ through ⅝ in. Crane Packing Co.

5—CONDENSER CLEANER is air or water operated

The Blo-Gun — a condenser cleaner which may be air or water operated — is designed for removing soft deposits, such as mud, and similar accumulations from condensers in steam power plants, and in refrigeration, air-conditioning and



process industries. The gun makes use of the plug shooting method. Light weight, minimum number of parts, long service and rapid functioning are announced as its chief features. It weighs only 2 lb, and has an aluminum housing with a removable bronze nozzle and rubber spray shield.

The gun is available with either a corded-rubber plug or nylon spiral brush, whose projectiles are furnished with outside diameters between ½ and 1 in. Both plugs and brushes may be used repeatedly. After plug or brush is placed in tube, the Blo-Gun nozzle is inserted and by a continued forward movement, compressed air or water is released, propelling the accessory forward through the tube. Thomas C. Wilson, Inc.

6—FLOAT VALVE for controlling liquid level

The 1620 Series Float Valve for controlling levels of liquids is suggested for use in air conditioning installations, power plants, textile mills, water works, packing plants, breweries, chemical plants. They are used to maintain level in open

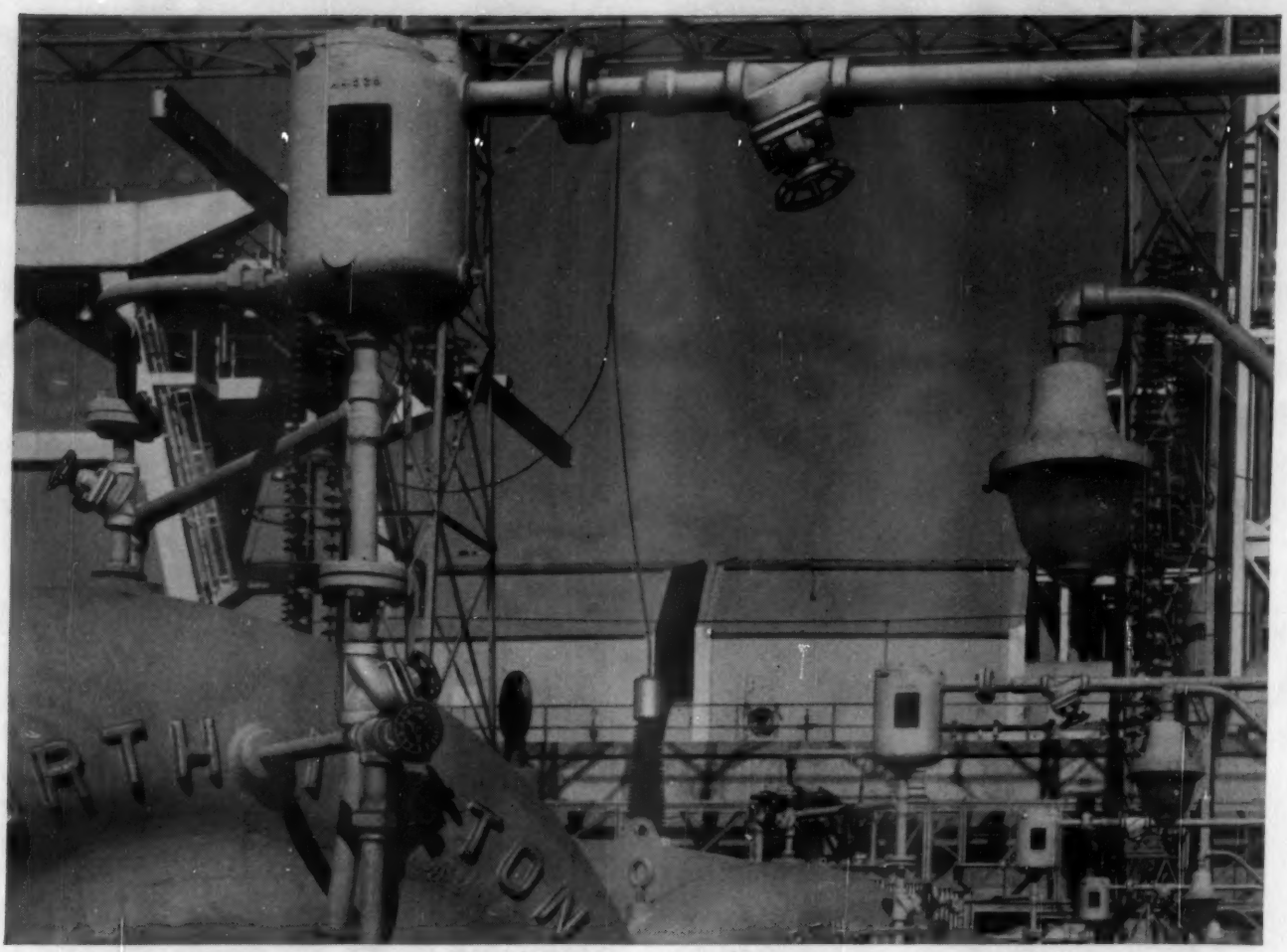
storage tanks, process tanks, spray ponds, cooling tower basins and similar liquid reservoirs. Construction is mainly bronze and steel, but the floats are also available in other metals for special applications. Requiring a minimum of maintenance, this direct-acting control can be ordered in 11 sizes, from ¼ to 4 in. Larger sizes are supplied with a semi-balanced, double-seated valve. This valve is preferred for many uses, particularly for slurries or liquids containing suspended solids. Fulton Sylphon Div., Robertshaw-Fulton Controls Co.

7—ACETYLENE TORCH is light-weight, multi-purpose unit

This new acetylene torch is announced as well balanced and light in weight to eliminate operator fatigue. The heads run cool enough to be handled immediately after operation, it is pointed out, which facilitates quick-changing. Although specifically designed to cope with increased use of silver soldering in plumbing applications, the new torch is declared fast enough for refrigeration work. It also provides the "pencil flame" for electrical work and has copper heads suited for sheet metal jobs. The complete outfit includes two handle assemblies and seven head styles. The regulator is solid brass. Also available with the outfit is a Bunsen burner which will work on the torch handle or separately as a complete unit. Ransome Co.

8—AIR CONDITIONER for multi-room installations

Introduced for year-round air conditioning in multi-room installations, Dual Conditioners use the existing heating piping circuit to cool in summer, heat in



Corrosive circulating water tamed here by these CRANE VALVES

THE CASE HISTORY—Almost 2 years' operation without any maintenance of valves on circulating water lines to condensers, and on priming and instrumentation systems—with no trouble in sight. That's the experience of Southern California Edison Company's 280,000 k.w. steam station at Etiwanda with Crane Packless Diaphragm Valves.

The plant's engineers knew that sediment in recirculated water would quickly cut out the seats in ordinary valves and its corrosive elements would attack working parts to make valve operation difficult.

Not so with Crane Packless Diaphragm Valves. Their sealed bonnet keeps working parts out of contact with line fluid—free of corrosive effects. Separate disc construction with pliable insert resists erosion—seats tightly even on foreign particles. Large or small, these valves operate easily with fewer turns to the cycle. Typical Crane quality throughout—they're made better to do the job better—a bigger value for the thrifty buyer.

CRANE No. 1610 PACKLESS DIAPHRAGM VALVES

No packing to maintain. Neoprene diaphragm has longer life because it seals the bonnet only—is not subject to the cutting and crushing encountered when also required to do the seating. Separate disc gives control of fluid even should diaphragm fail. Wide selection of materials and sizes. Write for folder AD-1942 or see your Crane Representative.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

For more data circle 533 on Post Card

winter, and ventilate in off-seasons. The system requires no ducts, it is pointed out, and can be used in fireproof buildings since fumes, smoke or flames cannot be transmitted from one room to another. Each room or area has an individual thermostat and capacity control; each unit is its own zone control, independent of others.

Manufacturer announces a choice of 10 UL approved units to meet varying capacity needs. The cabinets are described as rustproof and soundproof, and can be recessed. In conjunction with the existing hot water boiler, a water chiller is supplied to complete the year-round system. To cool and ventilate only, the Dual Conditioner may be connected to a standard refrigerating condenser unit. Circle Air Industries.

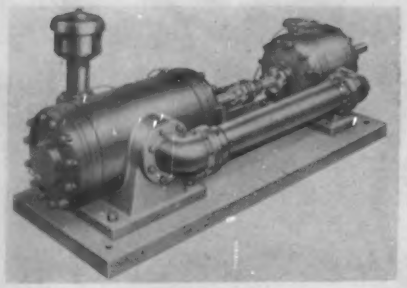
9—PLUG-IN CONTROLLER is compact, in horizontal case

This new plug-in millivoltmeter controller is available with three different control forms: on-off, two-position and three-position. The three-position control form incorporates a dual index and provides a neutral zone adjustable from 0 to 100 per cent of full scale (wide zone model) or 0 to 10 per cent of full scale (narrow zone model). The calibrated accuracy of the instruments is announced as ± ¾ per cent of full scale.

Prime advantage of the horizontal case (sheet steel, 19 in. wide, 6 in. high and 10¾ in. deep) is that it makes it practical to stack several instruments in standard relay racks. Other design features built into the controller make it possible to ship the galvanometer separately to decrease possibility of damage to it; also it is possible to check calibration without disconnecting wiring. Minneapolis-Honeywell Regulator Co.

10—MAINTENANCE COATING adheres to many surfaces

Hypalon Maintenance Coating (based on duPont's Hypalon chloro-sulfonated polyethylene) is announced as flexible, self-curing, readily applied in heavy coats, and having excellent adhesion to a wide variety of surfaces. It is said to have outstanding resistance to weathering, high temperature and highly corrosive fumes and liquids including nitric acid, chlorine dioxide, hydrogen peroxide and chromic acid as well as inorganic acids, alkalies and salts. Literature and test samples are available. The Atlas Mineral Products Co.



12—COMPRESSOR/VACUUM PUMP is water cooled

Two-stage 100-lb rotary air compressor/vacuum pumps are announced for shop air systems, pneumatic conveyors, gas compression, and similar applications. Water cooled, the compressor vacuum pump consists of a separate low pressure unit coupled to a high pressure unit, mounted on a common bed plate. It is designed for direct connection to motors; although it may be driven through speed decreasing or increasing gears by motors, engines or turbines. While of nominal 100-lb capacity, the unit is available in eight sizes to handle from approximately 250 cfm to 1800 cfm and for pressures ranging from 60 to 125 lb. Allis-Chalmers Mfg. Co.

13—TOTALLY ENCLOSED MOTOR is compact, well protected

Announced for applications requiring a completely enclosed unit, the Type J Motor conforms to recent NEMA dimensional standards and is more compact than company's previous models. Besides providing the same horsepower in less space, it is said to feature higher electrical characteristics and closer tolerances, also greater protection. And no general disassembly is required for access to bearings.

The Type J is engineered for operation where fumes, dusts and moisture are prevalent; its externally exposed surfaces are cast iron for corrosion resistance. Among other features of this motor are a solid cast frame structure, ribbed around the entire unit for strength and rapid heat dissipation; pre-wound stator core; and asbestos protected windings. The ventilating fan is housed in a cast iron guard. The Type J is being produced in ratings from 1 to 10 hp. Bulletin 1879 gives details on this enclosed motor. U. S. Electrical Motors Inc.

14—GAGE COCK designed for positive closing

For pressures to 450 psi, this gage (try) cock is designed for operation by chains and lever to rotate a multiple thread (quick-closing) stem. Positive closing is obtained by a steady pull on the right hand chain, it is explained, and an integral stop prevents lever from swinging to dead center on the open position. Internally, the cock has stainless cone valve ground and a monel metal seat. Mounting of cone in stem is such that floating action is provided to assure positive seating. Both cone and seat are renewable. Body of the cock is of bronze. A steel operating lever features an internal sprocket arrangement giving a choice of 18 nonslipping positions for selection of best lever location. Discharge nozzle is adjustable to direct steam and water away from operator into a drip funnel. Reliance Gauge Column Co.

15—PIPE FITTINGS of stainless steel to resist corrosion

These 150-lb stainless steel pipe fittings are announced as ideal for standard pressure services where corrosion is a factor. They are available in screw-end and socket-welding types in stainless

steel Types 304 and 316. Type 304, with a chromium content of 18 per cent and nickel 8 per cent, is highly resistant to corrosion and high temperature oxidation, it is noted. Type 316 has a chromium content of 18 per cent, nickel 11 per cent and molybdenum 2½ per cent — the nickel content and the addition of molybdenum increases corrosion resistance in a wide variety of services. The fittings are available in sizes ⅛ to 2 in. The smaller sizes are machined from solid forgings, the larger from stainless steel castings. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

16—DEMINERALIZER, is portable, mixed-bed unit

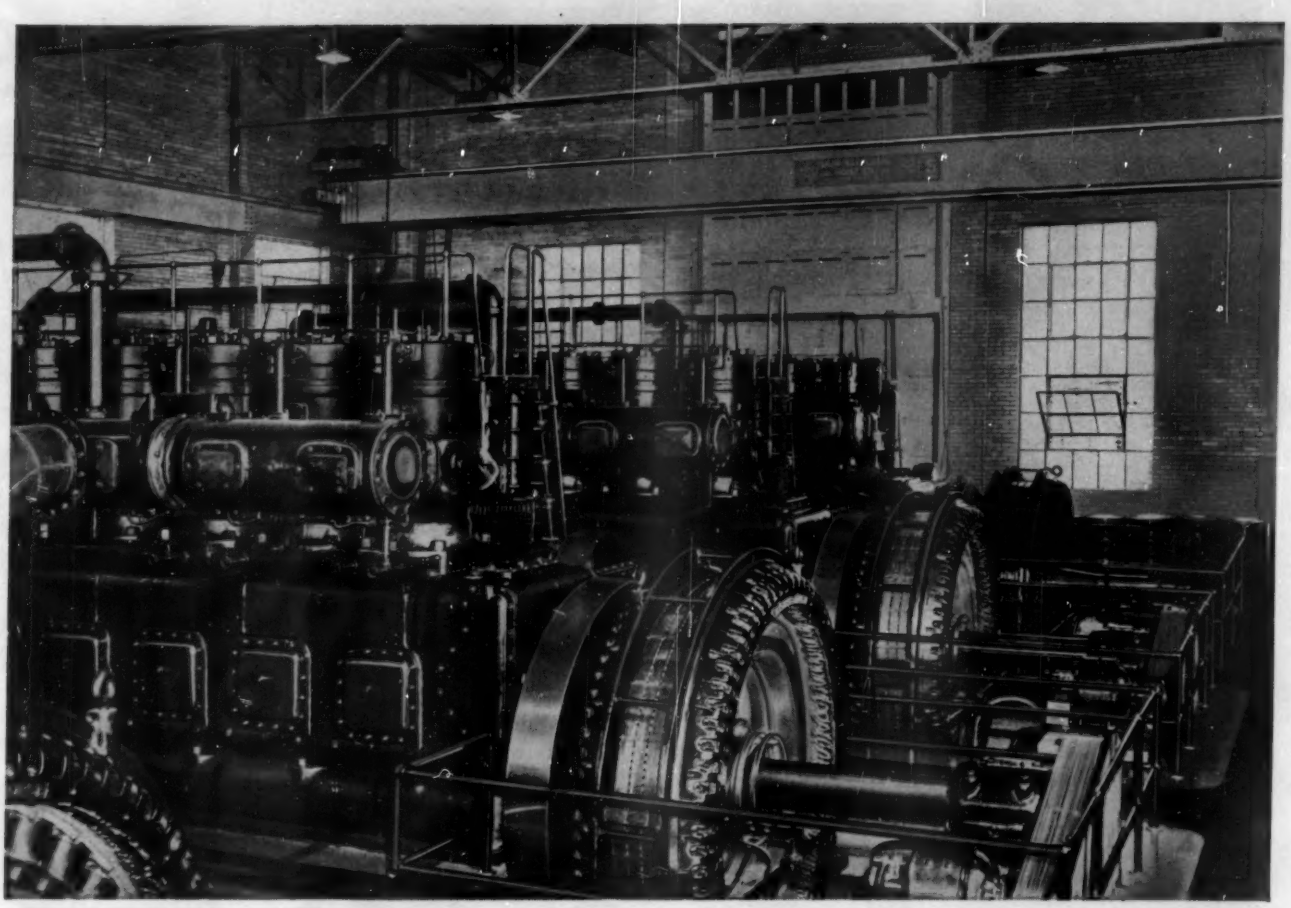
Introduced for the production of small quantities of pure water, the Model MBD-6A Demineralizer is a compact, portable device containing a bed consisting of an intimate mixture of Permutit Q, a cation exchanger, and Permutit S, a highly-basic anion exchanger. It is used to produce a water of low total dissolved solids, low CO_2, low silica content and low conductivity. In service, the inlet hose is connected to a raw water supply and the outlet connected into a pipeline or placed into the container where water is required. The faucet, to which the raw water inlet adapter is fastened, should be used to regulate the flow. The flow rate is 1 to 2 gpm maximum.

A conductivity meter (not shown) is used to indicate the dissolved solids content of the effluent water, and will thus show when regeneration of the exchange resins is required. The unit has a capac-

11—SILICON POWER RECTIFIER, high current, high voltage

Among characteristics announced for this type rectifier are efficiency of 99 per cent and ability to operate in extremely high ambient temperatures. It is small in size, occupying about an eighth of a cubic inch and weighing about 0.1 oz, of all-welded construction and hermetically sealed. It is designed to function under severe environmental conditions. The high efficiency claimed for the new unit is attributed to low voltage drop and infinitesimal reverse leakage current. Unlike other rectifiers which approach it in efficiency, the new silicon type may be used without derating in ambient temperatures of 100 C, says company.

Already in production are many types and sizes rated from 100 to 500 ma. The maximum forward drop at full rating is less than 2 v with blocking voltages from 50 to 500 v in the standard ratings, and up to 1000 v on special applications. Rectification ratios run as high as 10^8. The forward voltage drops average 1.5 v at 200 ma. The new rectifier is also said to possess practically flat Zener characteristics, which contribute to its usefulness as a voltage reference. Bogue Electric Mfg. Co.



"We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity*. Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save Wear and Replacement

For more data circle 534 on Post Card

ity of 1500 grains total dissolved solids. During each cycle or run it can demineralize 250 gal of raw water containing 100 ppm total electrolytes, or 125 gal containing 200 ppm total electrolytes. When the unit is exhausted, the resins may be replaced with a refill or regenerated and reused. The Permutit Co.

17—DRY TYPE AIR FILTERS help reduce engine wear

Dry-Type Micronic Air Filters are designed to prolong the life of diesel and gasoline engines and improve their operating economy. This new type of filter is described as smaller, lighter in weight and less expensive than comparable types, and, says manufacturer, it does not present such disadvantages as oil pullover, off-level operation or difficult cleaning. The Micronic element is of resin-impregnated, convoluted cellulose to prevent excessive or insufficient oil wetting. This element is said to provide efficiencies over 99 per cent with airborne particles of all sizes regardless of engine speed. It supplies cleaner air, thus reducing engine wear to abrasive particles. And due to the inherent vibratory characteristics of an engine, the dry-type filter is largely self-cleaning.

It is explained that because this filter offers little resistance to air flow it reduces pressure drop, keeps engine power at maximum and reduces fuel consumption. And its design features simplify replacement of many filters with the new dry type. Basic types in the new dry-type line are the manifold mounted type for up-draft; hat type for downdraft; and an outside cowl mounted type. Purolator Products, Inc.

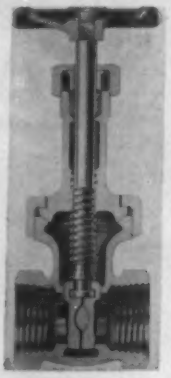
18—PRINTING DEVICE identifies recording charts

The Identichart is a compact device designed to automatically print a number, date or time on Brown strip charts and similar recorder charts at any instant when a voltage is applied to the device during process, test and control work. It makes it easy to identify individual sections of recording charts in relation to particular conditions taking place at a remote point. The unit mounts on the outside of the door of the recorder and, company says, it does not interfere with or obscure the recording procedure. It is made for 28 v d-c operation but can be adapted to other requirements.

For easy installation, the Identichart is supplied in kit form. The kit consists of a strip of rubber for the chart platen, mounting screws, Plexiglas window to replace the original one in the door, plastic transparent cover for the device itself and instructions for installing. Wires on the unit go to the power supply and switch. Royson Engineering.

19—GATE VALVES for oil, steam, water and gas

Sizes range from ¼ to 3 in. in this new line of bronze gate valves for general full-flow service on steam, water, oil or gas. The valves are available in either split or solid wedge, and have a rising stem which indicates the wedge position. Its operating threads are out of direct



contact with the fluid. The stems are made of Coradur, an aluminum-silicon-bronze alloy, for corrosion resistance.

Each valve is designed for a working pressure of 150 lb. End threads conform to American Standards; they may be used with pipe threaded to API standard for threads in valves. Kool-Grip malleable iron handwheels are used. According to company, the split wedge is especially suited for use where body seats might be slightly distorted due to pipe line strains. The solid wedge is designed for general use, and is declared particularly adapted for steam service. R-P&C Valve Div., American Chain & Cable Co., Inc.

20—PIPE AND FITTINGS in plastic, for industrial use

Now available is polyethylene plastic pipe in ½- to 2-in. sizes, and modified polystyrene insert fittings — ells, tees, couplings and adapters. The pipe is available in standard coil lengths as follows: ½ and ¾ in. in 400-ft coils; 1 and 1¼ in., 300-ft coils; 1½ in., 250-ft coils; 2-in in 200-ft coils. This plastic pipe is also available in 100-ft coils in sizes up to 2 in. Crane Co.

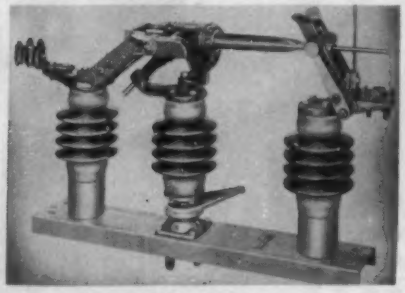
21—CHEMICAL FEED DEVICE designed for precise control

Designed to combine precise control with an accurate liquid level alarm, this chemical feed control apparatus comes in one small, high-visibility package. The unit can be used to regulate flow in any situation in which it is necessary to feed liquid chemicals, as in direct boiler feed and in many process purposes. Manufacturer says that one of its chief features is a high degree of adjustability in timing arrangements. The total time cycle, that of the chemical fed, and the length of non-feeding time can be set so that they will proceed automatically until chemical supply is exhausted or a new setting is decided upon.

The liquid level alarm consists of an electric probe in the chemical tank, set at such a level as to give warning in time to allow tank to be refilled before it empties completely. The warning bell begins to sound when the level in any tank falls below the probe and continues until the operator throws a switch. The bell is then silenced, but an alarm light remains lit until that tank is refilled. To identify the low tank, operator simply sees which light is lit on the control box — one light corresponds to each tank. When the tank is filled, the light goes out and the bell sounds again, notifying the operator, who then resets alarm silencing switch to its original position. This silences the bell and resets the level alarm. Graver Water Conditioning Co.

22—BREAK SWITCH has easily operated rotating blade

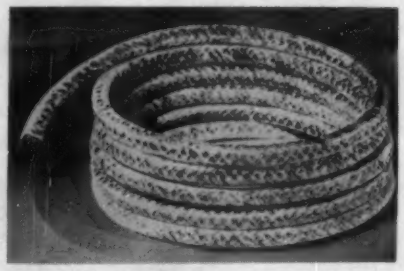
This switch features a direct current path with a minimum of contact points. It has an easily-operated rotating switch blade, high pressure contacts at both



ends, heavy silver surfaces at all contacts and, manufacturer states, it will lock safely in both open and closed positions. Operation is facilitated by concentration of initial torque on rotating the blade, and only enough subsequent force is needed to raise the weight of the blade. This design reduces abrasion of contacts and stress on other parts, it is noted, and is especially effective for use under icy conditions. Bulletin 333 gives more details. Electrical Engineers Equipment Co.

23—LOW FRICTION PACKING high in tensile strength

Super-Lon is announced as a low friction packing for hot corrosives which will withstand such chemicals as fuming

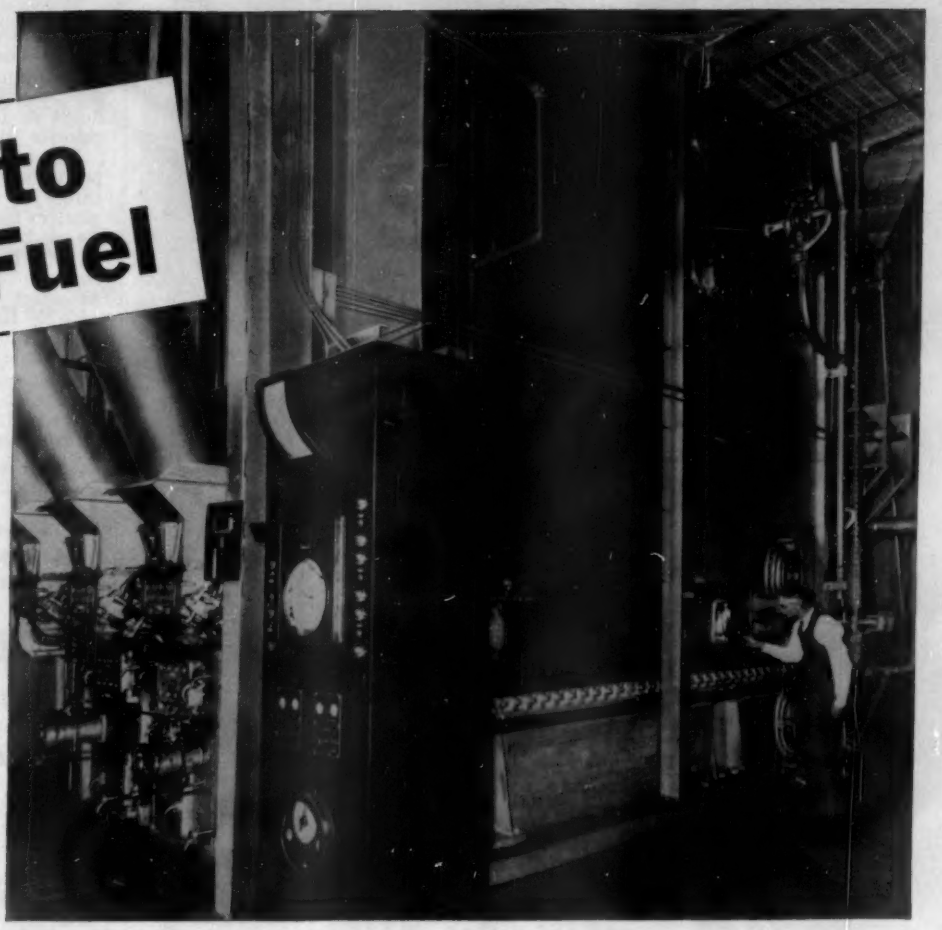


acid, concentrated sulphuric, Oleum or concentrated sodium hydroxide and even aqua regina at temperatures to 550 F. A braided Teflon fiber, it has great tensile strength, according to manufacturer, and will not seize high speed shafts. Chesterton Mechanical Packings.

24—PROPORTIONING PUMP with choice of plastic ends

Designed to meet the need for a proportioning pump capable of handling highly corrosive fluids, this company's "U" type pump is now offered with two types of plastic liquid ends. Pump body and check valve assemblies are unplasticized

How to Save Fuel



Fuel savings of 15% have resulted from steam plant modernization at General Mills, Inc., Buffalo, N. Y. The program included this installation of Bailey Meter Control on a 45,000 lb per hr, 170 psi spreader stoker-fired boiler.

● The heat energy you get from a unit of fuel depends on the performance of your steam plant equipment. And that's where Bailey controls can help. With a Bailey-engineered control system you can count on a higher output of available energy per unit of fuel. Here's why:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record. A-121-1

FORMULA
for Cutting
Production Costs
•
+ Bailey Design
+ Bailey Engineering
+ Bailey Service
= Greater Savings
per Fuel Dollar

BAILEY
METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

For more data circle 535 on Post Card

New WATSON-STILLMAN
150 LB. STAINLESS STEEL
PIPE FITTINGS, *Types 304, 316*

Now you can get performance-proved Watson-Stillman Fittings for standard pressure services that need the corrosion resistance, heat resistance and low temperature toughness of 18-8 Stainless Steel.

W-S 150 lb. Stainless Fittings, rated at 400 psi cold non-shock working pressure and 150 psi steam pressure, are ideal for process piping, refrigeration systems, high temperature liquid and gas piping and other piping systems. They are available in both Screw-End and Socket-Welding Types in sizes ⅛" to 2".

The new Watson-Stillman Stainless Steel Fittings will assure you of long, trouble-free service in tough piping applications... will reduce down-time and cut maintenance costs. For full technical information on these fittings write today for Bulletin S-3-55.

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

10

polyvinyl chloride or Kel-F. Used in conjunction with ceramic pump plungers and ceramic check valve balls, these plastics offer excellent resistance to such fluids as ferric chloride, sodium hypochlorite, cupric chloride, others.

The pumps have capacities to 19 gph per feed and are available in one-, two-, three- or four-feed units. Pumps with plunger diameters from ¼ to ½ in. may be used to develop pressures to 300 psi; ⅝ to 1 in. plunger diameters, for pressures to 150 psi. Maximum temperature at which PVC pumps can be used is 150 F; Kel-F pumps may be used at temperatures to 250 F. Plastic liquid end assemblies and check valves are also available to convert existing metal "U" pumps to plastic construction, and are interchangeable with the metallic liquid ends. Hills-McCanna Co.

Reader Service Cards on pages 119–120 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

25—WATER HOSE is more easily visible underground

Golden Vim water hose, designed primarily for underground water service, is made with a bright yellow cover to make

the hose more visible during underground water service. This, company points out, helps eliminate hazards to workmen, as well as accidental damage to the hose itself. The tube is especially compounded for resistance to water absorption, while the cover is designed to withstand severe service conditions. Although constructed especially for mining service, its flexibility and strength make it applicable in other industries as well. It is offered in ¾ in. I.D. and 1 in. I.D. Boston Woven Hose & Rubber Co.

26—CLOSING DEVICE uses liquid carbon dioxide

The Cooperator — a circuit breaker closing device which uses liquid carbon dioxide as the source of power — is announced for operation independent of the regular source of control or power. It is portable and, manufacturer reports, has adequate power to close the breaker against fault currents equal to its full momentary rating. It has a standard 10 lb bottle of CO_2 as a source for stored energy, a regulating valve, an intermediate receiver for holding the required amount of carbon dioxide gas for each closing operation at about 220 psi, a control valve which releases the gas from the intermediate receiver to close breaker, and a power cylinder and piston for closing circuit breaker. Up to 75 closing operations are obtainable from a single bottle of liquid CO_2. A reserve bottle is included to assure full supply

New Prudential Building to burn coal the modern way

Ultra-modern in all respects, the new 41-story building of the Prudential Insurance Company of America in Chicago incorporates the latest developments in design, fixtures and construction. This beautiful structure will be completely air-conditioned and will offer its occupants all possible conveniences.

Among those conveniences will be Prudential's heating system, as up-to-date as the building itself. This most modern building in the country will burn *coal.* Cleanly. Efficiently. And its completely automatic coal handling and burning installation will provide sure, even heat *economically* under all conditions.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

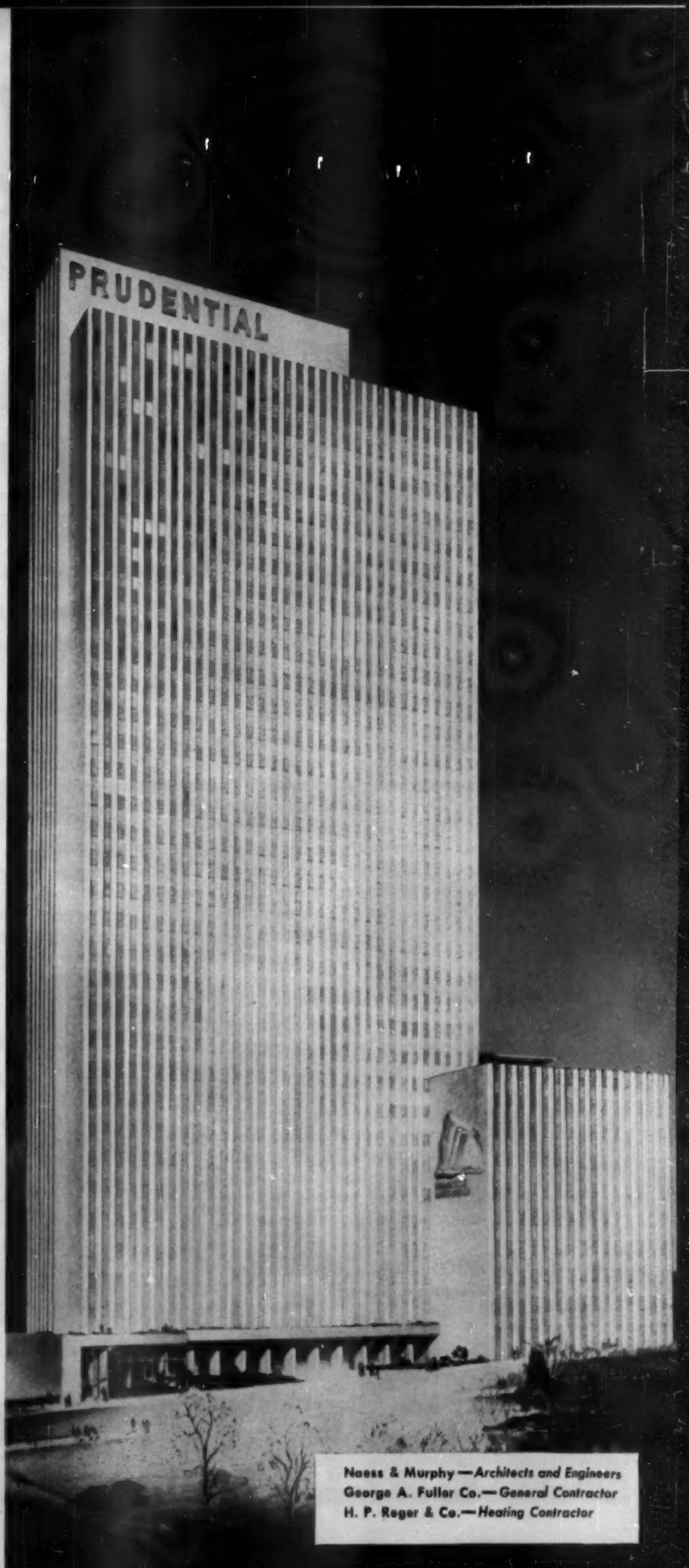
In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

For more data circle 537 on Post Card



Naess & Murphy—*Architects and Engineers*
George A. Fuller Co.—*General Contractor*
H. P. Reger & Co.—*Heating Contractor*

New Reliance Gage Cock

for 450 psi and lower pressures

features quick positive shut-off

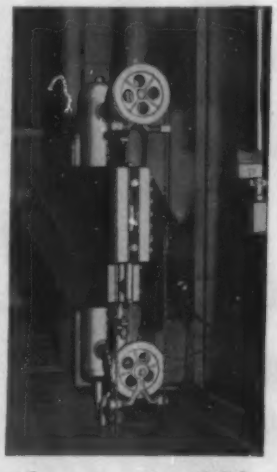
No. GC450—½" shank

No. GC451—¾" shank

Positive chain-pull operation, renewable cone valve and seat, and adjustable lever are features of this new Reliance Gage Cock. Patterned after our popular forged steel cock for higher pressures, the new GC450 has *bronze* body and is designed for 450 psi and lower pressures. Cone of stainless steel and seat of monel metal offer unusual resistance to cutting action of steam and water. Both are renewable. Quick-closing (¼ turn) screw action. New-type lever has 18 non-slip positions. Adjustable discharge nozzle. Write for complete information.

Reliance Water Columns & Trim

Products of this oldest maker of water column equipment include columns for all pressures and latest developments in water gage valves, gage inserts, direct-to-drum gage assemblies and gage illumination. Shown at right — 1100 psi forged steel Reliance Water Column with mica-protected high pressure flat glass two-window gage insert made faster and easier to read by our Mercury Lamp Illuminator and direct vision hoods.



The Reliance Gauge Column Co.

5902 Carnegie Ave., Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

at all times. The device will close all current designs of magneblast circuit breakers in the interrupting range from 100 to 500 mva, in metal-clad switchgear. General Electric Co.

27—MASTIC designed for safety during application

Spraying of protective mastic coatings onto metal and insulations is relieved of the danger of flash fires with Safetee Mastic (60–80), according to manufacturer. It is said to combine fire safety during application and long, fire-resistive weatherproof protection of the coated equipment. The new mastic is listed by Underwriters' Laboratories for use as a fire-retardant weathercoating on thermal insulation, it is noted, and in addition to its freedom from flammable solvents, it possesses superior "breathing" properties for application over insulation on heated vessels — moisture vapors may escape through the weather-coated insulation without blistering or otherwise damaging the finish. Also, this mastic is claimed to provide maximum weather protection, minimum shrinkage or cracking and good resistance to chemical attack. Benjamin Foster Co.

28—STEEL VALVES feature improved internal design

Improved internal streamlining, which lessens wear and reduces pressure drop, is announced for this re-designed 600-lb line of globe and angle stop, check and

non-return cast steel valves. Features formerly available only in company's 900, 1500, and 2500 lb valves, are now incorporated into the 600 lb valves for easier operation and reduced maintenance. Among these are swivel disk construction, stellite faced disks guided the full length of travel using integrally cast guide ribs, integral stellited seats and the Impactor handwheel.

Valves in sizes of 8 in. and larger also feature an improved pressure-seal bonnet joint which gives more sealing force and sealing area. This pressure-seal design is claimed to eliminate leakage, and afford easy disassembly and lasting bonnet joint tightness regardless of temperature. Edward Valves, Inc.

29—STORAGE BATTERY for emergency lighting use

Eight to 12 years of useful life is anticipated for the 3-COE-7 Tytex Battery, a plastic-cased battery designed specifically for emergency lighting. It is announced as approved by Underwriters' Laboratories. Contributing to the long

STRENGTH

for Safety and Long-Time Service

For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

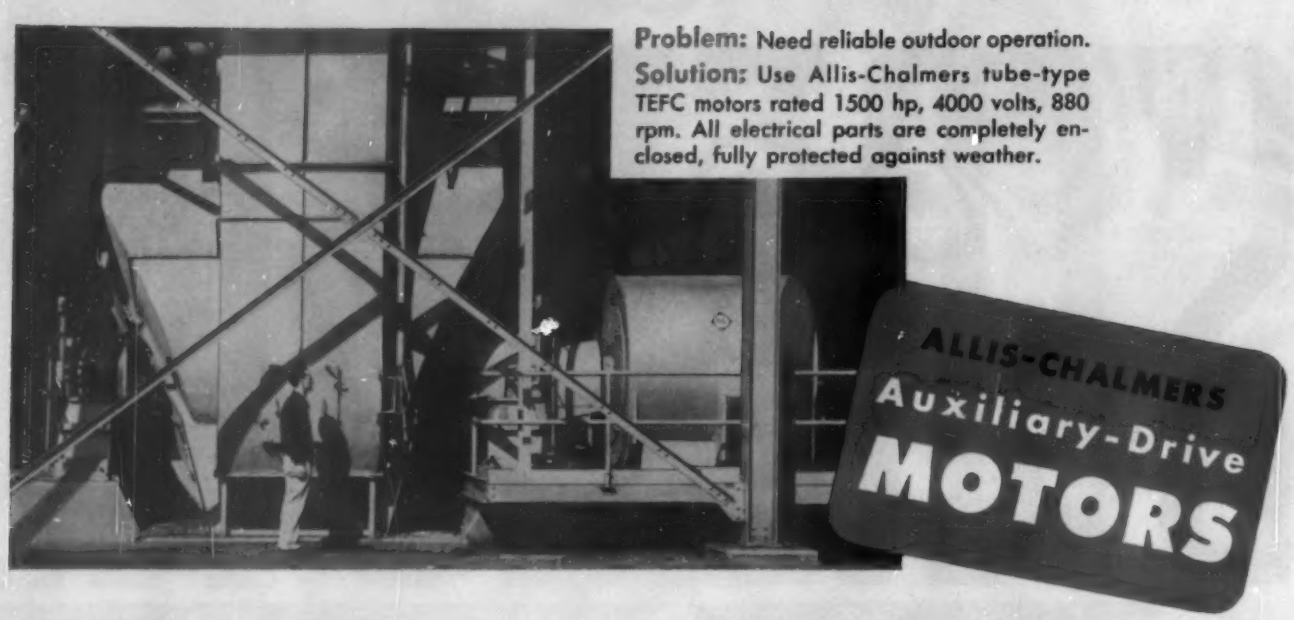
Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-9 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt DROP FORGED STEEL FITTINGS

For more data circle 539 on Post Card



Problem: Need reliable outdoor operation.

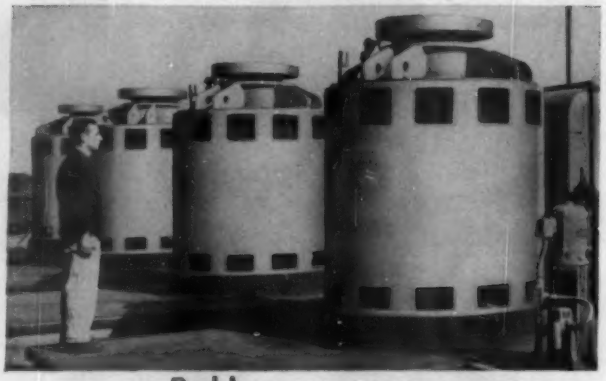
Solution: Use Allis-Chalmers tube-type TEFC motors rated 1500 hp, 4000 volts, 880 rpm. All electrical parts are completely enclosed, fully protected against weather.

3 Problems — 3 Solutions

Eastern Utility Gets Exactly the Right Motor for Each Job from Allis-Chalmers

Public Service Electric and Gas Company chose Allis-Chalmers motors for many of the major auxiliaries in their Kearny (N. J.) Generating Plant. The reasons: reliability and economy.

Allis-Chalmers builds a type and size for every auxiliary drive in the power plant. Whether your problem is space, fly ash or an outdoor location, there's a motor in the Allis-Chalmers line to provide the continuity of service you need. Let an Allis-Chalmers representative help you select the motors for your job. A-4582

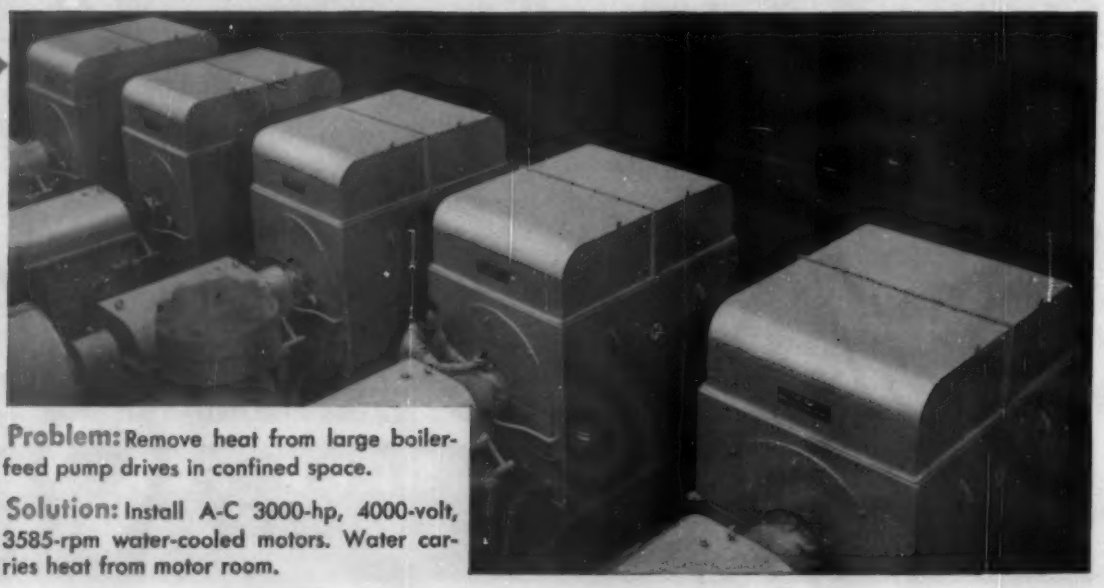


Problem: Keep building costs down.

Solution: Put pump drives outdoors, using Allis-Chalmers tube-type TEFC motors rated 350 hp, 440 volts, 400 rpm.

ALLIS-CHALMERS

Milwaukee 1, Wisconsin



Problem: Remove heat from large boiler-feed pump drives in confined space.

Solution: Install A-C 3000-hp, 4000-volt, 3585-rpm water-cooled motors. Water carries heat from motor room.

For more data circle 540 on Post Card

life of this battery are ¼-in. thick pasted type positive plates and active material of special formulation. Negative plates of heavy construction are in balance with positive plate characteristics, says company, and the active material is locked into both plates by a series of horizontal and vertical grid members. This construction is said to assure permanent contact between active material and the grid structures carrying the electrical current. These features are designed to provide low internal resistance, which increases useful service life.

Short circuits are claimed to be prevented by triple insulation with inert plastic and rubber. State of charge is indicated by colored pilot balls floating in a vertical channel molded into one corner of the Polystyrene container and cover. The battery requires addition of water once or twice a year under normal circumstances. Exide Industrial Div., The Electric Storage Battery Co.

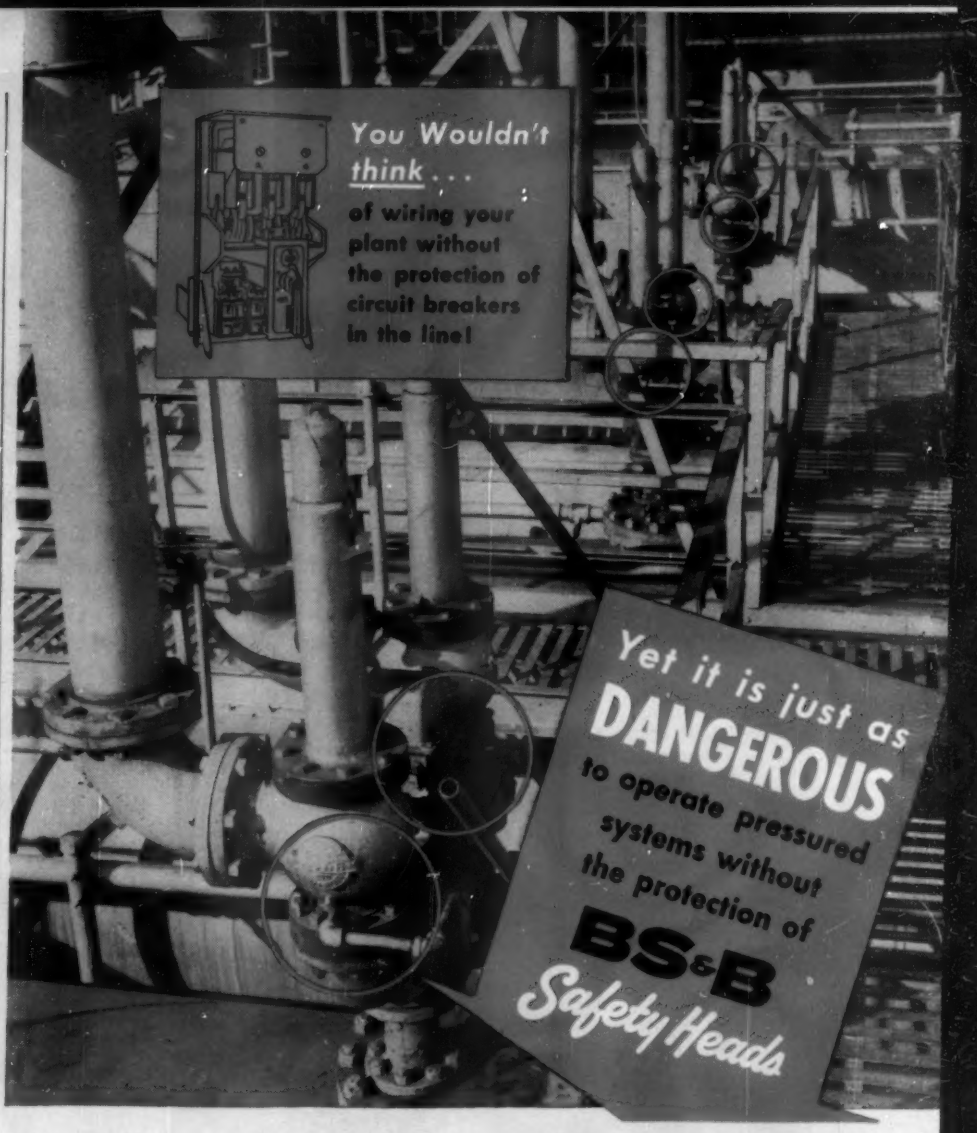
30—SYNTHETIC COATING is spray- or brush-applied

Neoprene W is announced as an economical, one-component neoprene synthetic coating which is easily applied by brush or spray and cures at room temperature. It is suggested for protection against most acid and alkali fumes, splash and high humidity, and it is said to show excellent resistance to abrasion and weathering.

This coating's chief advantages lie in its simplicity of application, says company. No catalysts or accelerators are required — only wirebrushing of metal surfaces to remove dirt, rust and scale. This is followed with one coat of Neoprene W primer and two coats of Neoprene W for final thickness of 8 mils, on either flat or vertical surfaces. Drying time between coats is about 2 to 3 hr and in most cases coated surface can be placed in service after 24 hr. Coverage is 420 mil ft per gal. It may be used in chemical processing plants, water treatment and sewage plants, pulp and paper mills, food processing. Surfaces can be easily recoated or repaired. Repairs necessitated by mechanical damage or excessive wear can be made with Neoprene W, and the bond of the repaired section is said to be as strong as the original coating. Carboline Co.

31—TANK CLEANER uses hydraulic scrubbing

The Rotor Jet Tank Cleaner, featuring three-dimensional rotation of a high pressure hydraulic jet, delivers two streams of hot or cold water, with or without detergents, over the inside surface of any shaped tank. The portable cleaner, handled by one man, is lowered through the tank access by means of its supply hose. Since it is controlled from the outside, there is no need for the operator to enter the tank. Cleaning speeds are adjustable — high speeds for light cleaning or rinse; slow speeds for heavy cleaning give longer hydraulic scrubbing and greater heat transfer to tank surface. The two jets, powered by a venturi-injector, provide high velocity streams, manufacturer states, so that a scrubbing rather than a cascading action results. The jet head is rotated pneumatically, utilizing full hydraulic power for cleaning. The unit is available in three models for discharge capacities from 600 to 6000 gph. Bulletin 431 gives more details. Sellers Injector Corp.


You Wouldn't think . . .
of wiring your plant without the protection of circuit breakers in the line!
Yet it is just as DANGEROUS
to operate pressured systems without the protection of
BS&B
Safety Heads

Just as an electrical circuit breaker protects your personnel, plant and equipment from electrical overloads, shorts and "burnouts", so does the BS&B Safety Head protect them from the dangers of overpressure in pressured systems.

The BS&B Safety Head is a pressure relief device that is designed to become an integral part of any pressured system containing air, gas or liquid — either bland or corrosive.

The rupture disc of the BS&B Safety Head is custom fabricated to the specific requirements of the system of which it is a part. It provides a full pipe-sized vent for *instantaneous* relief before the pressure exceeds the safety limits of the system.

The BS&B Safety Head is especially suited to use in oil and gas producing fields, pipe lines, refineries, chemical plants, power plants and the refrigeration industry. It may be used as either a primary or secondary relief device, and either upstream or downstream from a relief valve, as varying conditions may require.

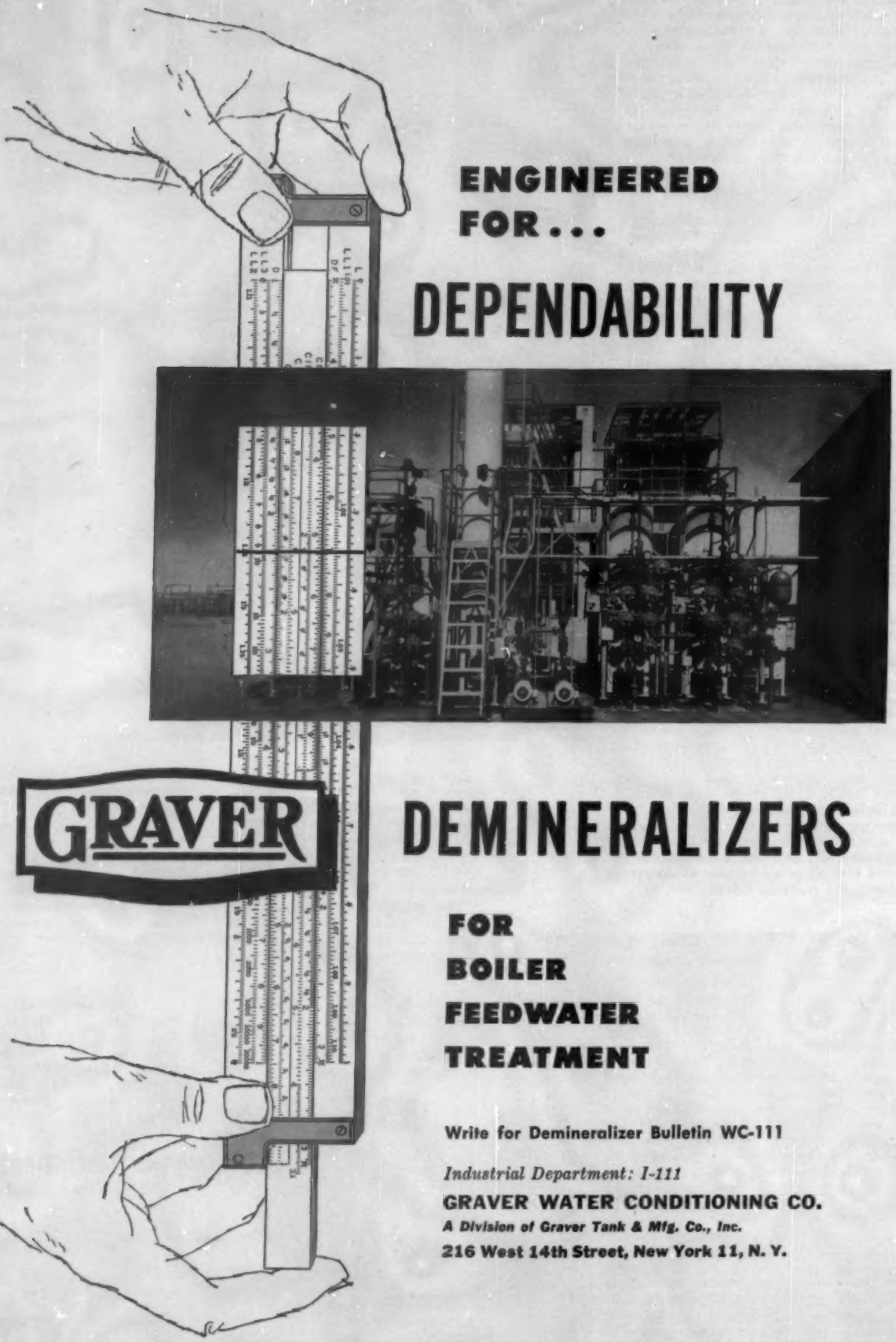
If you aren't already using BS&B Safety Heads in *your* plant, we'd suggest you get in touch with your nearest BS&B representative without delay. Or write for complete BS&B Safety Head Catalog. There's no obligation.

BS&B
Safety Heads

THE "CIRCUIT-BREAKER" OF *Any Pressured System*

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-R4
7500 East 12th St., Kansas City 26, Mo.

SAFETY BS&B HEADS OVER 60 YEARS



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DEPENDABILITY

GRAVER

DEMINERALIZERS

FOR
BOILER
FEEDWATER
TREATMENT

Write for Demineralizer Bulletin WC-111

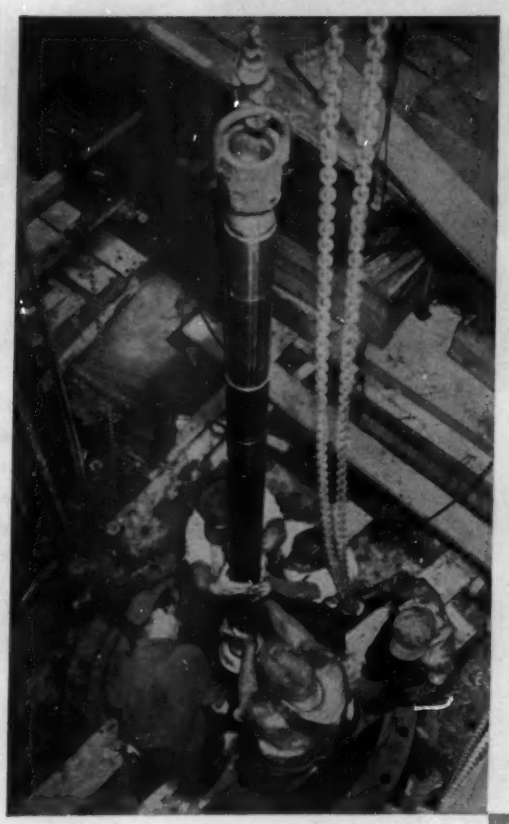
Industrial Department: I-111

GRAVER WATER CONDITIONING CO.

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th Street, New York 11, N. Y.

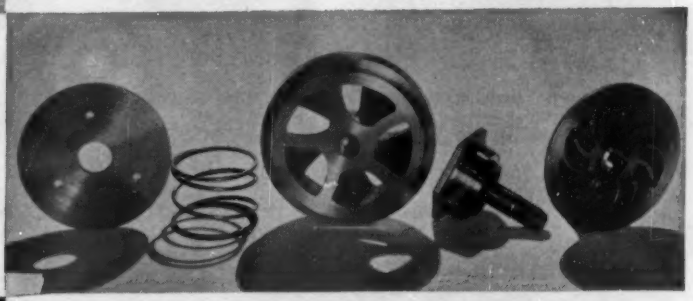
For more data circle 542 on Post Card

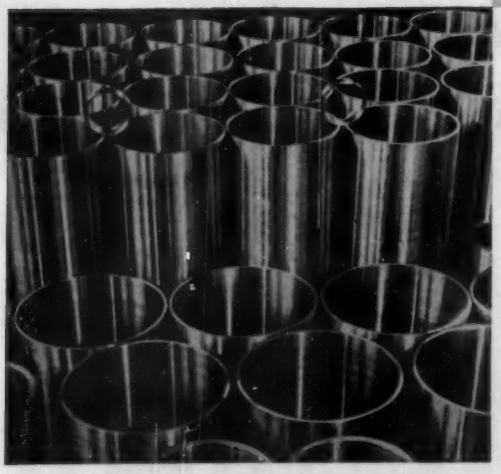


"K" Monel pump shaft being installed by utility company to avoid costly periodic breakdowns previously encountered with steel shafts in pumps circulating polluted and corrosive salt water. "K" Monel can be heat treated for great strength and hardness.

Monel pump valve for reciprocating circulating water pump withstands severe erosion-corrosion. Monel's tensile strength and resistance to fatigue are as high or higher than those of structural steel.

Ripe old age for pump parts





Cast "S" Monel liners reduce wear on pistons where gritty corrosive liquids are found. The resistance of "S" Monel to cavitation-erosion makes it ideal also for impellers in centrifugal pumps. Users have reported "S" Monel impellers lasting 3 to 30 times longer than other materials.

Some pumps are built to last; others aren't. But you can increase the service life of your pumps if you choose pump parts with the right kind of "life insurance." That means parts made of materials with exceptional resistance to corrosion, fatigue, erosion and wear; parts of high strength and hardness.

Outstanding among these more durable materials are the Inco Nickel Alloys like Monel®, "K"® Monel and "S"® Monel. A majority of pump users have found that with these alloys, pump parts last much longer.

The next time *you* have to repair one of your pumps, ask your pump manufacturer to duplicate the part in one of the Inco Nickel Alloys. And write Inco for the helpful booklet, *How to Get Longer Service from your Pumps.*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

More POWER for you . . . with MONEL INCO TRADE MARK **Nickel Alloys**

For more data circle 543 on Post Card

"Build us a Long Retract..

this was the problem

Designers have talked of boilers 60 or more feet wide, but it had seemed impossible to clean them. Now this problem has been solved by the Vulcan long retract shown at the right. With two entering the furnace from opposite sides, boilers larger than have ever been built can be cleaned dependably.

THIS Vulcan long retractable soot blower has been thoroughly tested. It has dual electric-motor drive. It has the double-helix cleaning pattern that has made Vulcan the standard for effective cleaning of furnaces up to 50 feet wide. Yet, for all its length, it is compact. It is easy to install, operate and maintain. With this new T-30, Vulcan is ready to clean your most modern boilers, no matter how large or how small they might be.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

VULCAN Automatic

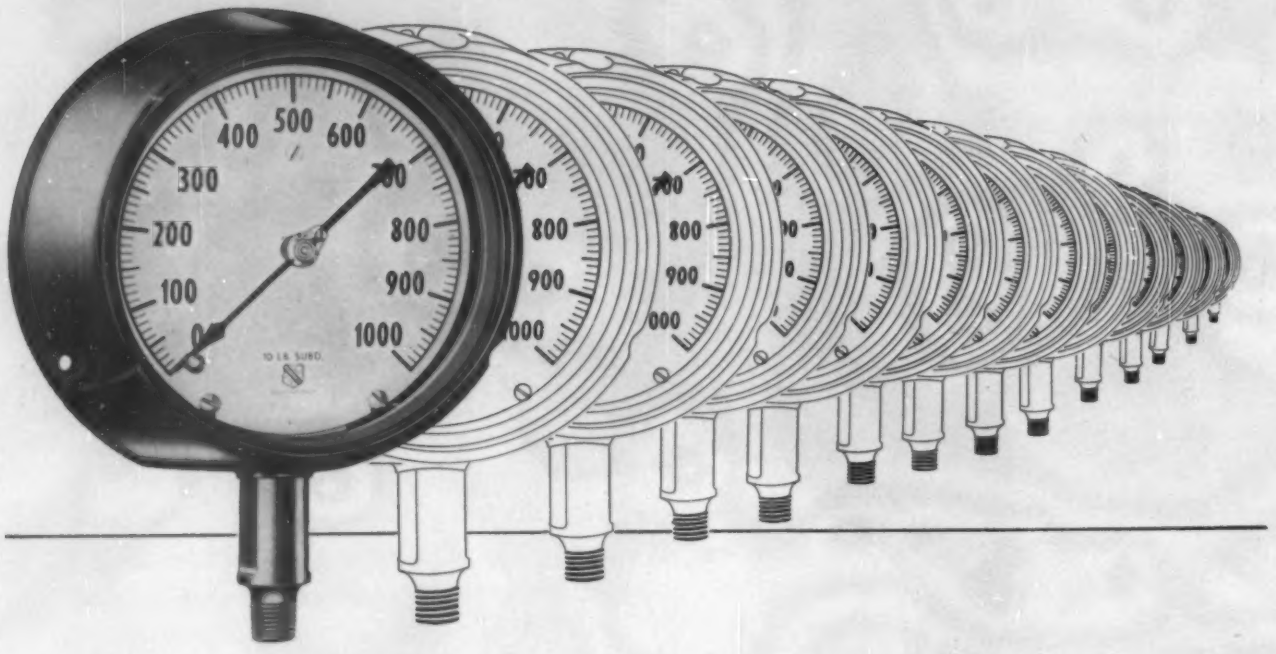
. . . and we do mean Long"

VULCAN
KNOW-HOW
COSTS MORE
—But is Worth it

Soot BLOWERS

For more data circle 544 on Post Card

SATISFACTION MULTIPLIED
3x8x8x38x2x5



Service Conditions primarily determine the pressure gauge you specify for your installation. The wrong gauge can cost time, trouble, and money.

That's the big reason why Ashcroft Duragauges make sure of your complete satisfaction by offering a multiple choice in case designs and materials, Bourdon tube materials, ranges, movements, and dial sizes. Briefly, you can select the right gauge for your requirements from:

Cases of 3 different materials in 8 service-proved designs.

Bourdon Tubes of 8 different types of metals to meet specific service requirements.

Pressure Ranges from 30" vacuum or a few ounces through 100,000 psi.

Rotary Geared Movements that include the famous "Nylon Movement" or all stainless steel.

Dial Sizes from 4½" through 12".

Most important, Ashcroft Duragauges provide that unbeatable combination of highest sustained accuracy and durability of any pressure gauge built.

TAKE ADVANTAGE of the counsel of your nearby Industrial Supply Distributor. You can count on him to help you select Ashcroft Duragauges that will serve better and longer, with minimum maintenance, no matter how severe the conditions of vibration, pulsation, corrosion and weather.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

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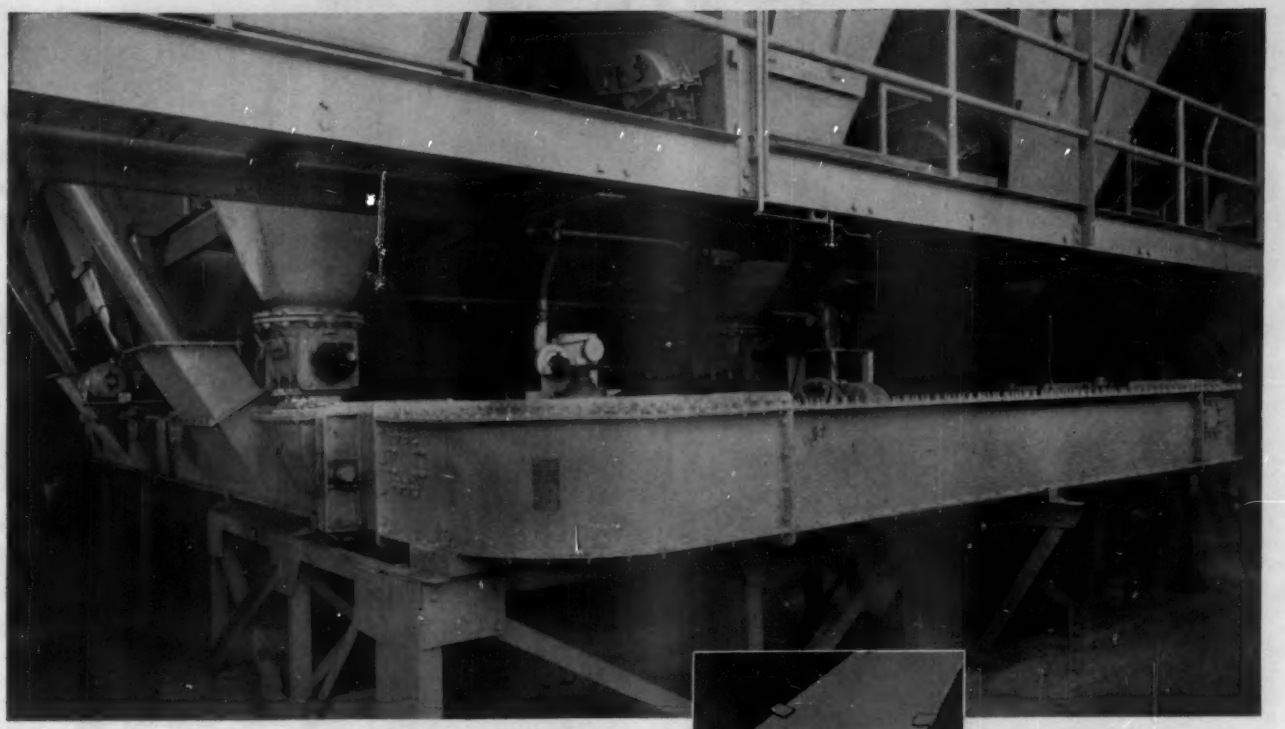
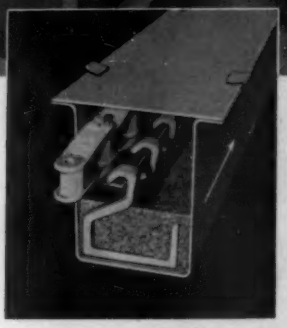




One of the twin REDLER installations, each consisting of two units, for fly ash disposal. A 5" REDLER runs along the center line of this rectangular, recirculating unit and discharges into it. The complete unit can deliver 25 T.P.H. to the dust pump for disposal. Inset: Section of closed circuit sidepull REDLER.

Distributes Coal - Collects Fly Ash

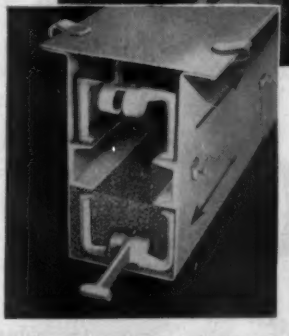
AT KEARNY GENERATING STATION

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

Feeds Coal to Grinders at 16 Points and Collects Fly Ash from Battery of Precipitators

Design permitting almost unlimited feed and discharge points and choke feeding without jamming dictated the selection of this REDLER Conveying System. A further advantage is the fact that the System insures practically dust-free handling for both coal and fly ash.

This ability of REDLERS to feed or discharge at many points makes it relatively easy to custom-engineer REDLER Systems to meet individual handling and distributing requirements. Compact, dust-tight and requiring only a minimum of supporting construction, REDLERS are economically adaptable to practically any plant layout. Mail the coupon to find out what they can do for you.



One of the seven 19-inch coal distributing REDLERS that move minus 1¼" coal at rates up to 165 T.P.H. each. REDLER installations similar to that at the Kearny Station have been made at three other Public Service stations. Inset: Section of standard REDLER.

STEPHENS-ADAMSON MFG. CO.

86 Ridgeway Avenue, Aurora, Illinois
Los Angeles, Calif., Belleville, Ontario

Engineering Division	Specialists in the design and manufacture of all types of bulk materials conveying systems.
Standard Products Division	A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls,—etc.
Sealmaster Division	A complete line of industrial ball bearing units available in both standard and special housings.

STEPHENS-ADAMSON MFG. CO.
86 Ridgeway Ave., Aurora, Illinois

Please send me your Bulletin No. 140 on REDLER Conveyors.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

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NOW!

An Entirely New Method For Sizing Controls!

BS&B's New, Exclusive Method Takes Both The GUESS And The WORK Out Of Controls Sizing For Liquid, Steam And Gas Applications!

Today's modern and complex processing systems require accurate control valve sizing. No one has recognized this fact more than BS&B.

Therefore, as a service to industry, BS&B set out to develop a new, simple, more accurate method of sizing controls. Here it is in the new BS&B Controls Sizing Manual.

This new, exclusive method uses two new "tools" to make sizing more accurate–the SIZE-O-GRAPH to determine what the valve MUST do and Cv RATINGS to determine what the valve WILL do.

These "tools" are based upon thousands of hydraulic flow tests performed on all sizes and types of BS&B Controls in the industry's largest and most modern flow testing laboratory. Results are proven by correlation with *actual* gas and steam flow tests.

If you'd like a copy of this new manual, write to . . .

OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-R4
7500 East 12th Street, Kansas City 26, Missouri

For more data circle 547 on Post Card

Walnut cracks tough problem in lubrication —chooses STANDARD HD OIL

William G. Eslick, Plant Superintendent, goes over lubrication and overhaul records with Standard Oil lubrication specialist Albert J. Thomas. Working with customers to help crack tough lubrication problems is Al Thomas' business. Al has the training and experience for such jobs. A graduate of Iowa State College with a B.S. in Mechanical Engineering, Al joined Standard Oil in 1950. After completing Standard's Sales Engineering School, he began working with industrial accounts on their lubrication problems. Customers of Al's find his experience and training pay off for them.

THERE WAS LUBRICATION TROUBLE in the power plant at Walnut, Iowa. The three diesel engines in the plant were experiencing stuck rings, excessive crankcase deposits and hard carbon deposits. Engines were sluggish and would not produce full power.

William G. Eslick, Plant Superintendent, working with Standard lubrication specialist, A. J. Thomas, decided on a course of action: he switched the engines to STANDARD HD Oil. Now, after more than 26,000 hours of operation, engines are clean. Ring sticking is eliminated, wear reduced to a minimum. Carbon deposits are reduced and remaining carbon is easily scavenged because it is now soft and flaky, not hard as before.

The initial fills of STANDARD HD Oil—plus make-up—are still in the engines. The community of Walnut, Iowa, is getting first rate electric service. Its power plant's lubrication problems have been licked. STANDARD HD Oil has again demonstrated its superior lubricating characteristics.

Perhaps you would like to know more about STANDARD HD Oil. In the Midwest a call to your nearby Standard Oil lubrication specialist will bring a prompt response. Or contact, Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (Indiana)

STANDARD

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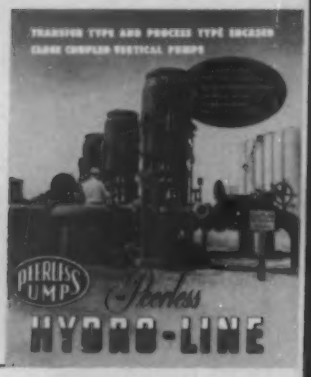
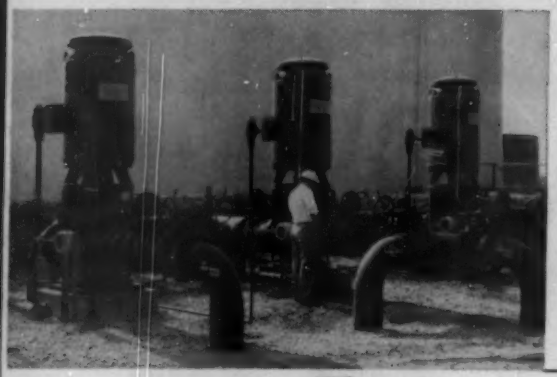
new VERTICAL Versatility

THE TREND IS TO VERTICAL PUMPS FOR TRANSFERRING MANY TYPES OF PROCESS LIQUIDS





HERE ARE TWO PEERLESS PUMPS THAT MEET THE NEED WITH ECONOMY, EFFICIENCY AND DEPENDABILITY—The two new Peerless pump bulletins shown at the left above describe the two types of modern Peerless process liquid pumps shown installed at the right.

Write for your copies. They describe and illustrate the pluses of Peerless vertical process pump design, construction and operation.

Bulletin No. B-1700 describes Peerless Hydro-Line can type pumps; Bulletin No. B-505 describes Peerless industrial service pumps. Both types are applied to the successful transfer of processing liquids. *Use the coupon below.*

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles 31, Calif. and Indianapolis 8, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send bulletins checked below:

☐ PEERLESS HYDRO-LINE CAN TYPE PUMPS B-1700

☐ PEERLESS VERTICAL INDUSTRIAL SERVICE PUMPS B-505

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

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Delivery...ON TIME...

A delay on this particular job meant valuable time lost . . . dollars wasted . . . Ric-Wil, not only prides itself in offering the finest in prefabricated insulated piping, but takes pride in ON TIME DELIVERY . . . and speaking of delivery . . . the best way to meet piping construction schedules is to contact your Ric-Wil representative early in the planning stage. He will be glad to help on scheduling delivery . . . and "lend a hand" on technical information as well.

New Ric-Wil catalog is available . . . write for your copy . . . now.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED

PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

For more data circle 550 on Post Card

new WIDER VISION

for easier remote boiler water level readings

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

A new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as front of the indicator. Boiler water levels and other liquid levels can be checked from most any position.

Indicating mechanism is operated by the boiler water level itself—assuring instant, accurate readings.

Yarway Indicators are of the manometric type with automatic temperature compensation, as approved for use under the recent A.S.M.E. Boiler Code Committee ruling in Case #1155.

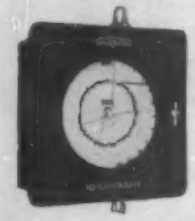
Over 10,000 are used throughout industry for boiler water and other liquid level indication . . . and for superheater pressure differential indication aboard ship.

For full information write for Bulletin WG-1824.

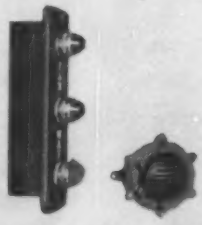
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

A COMPLETE YARWAY SYSTEM

Besides Remote Liquid Level Indicators, Yarway also offers Liquid Level Recorders and Remote Signal Alarms . . . making a complete system for constant, accurate liquid level check.



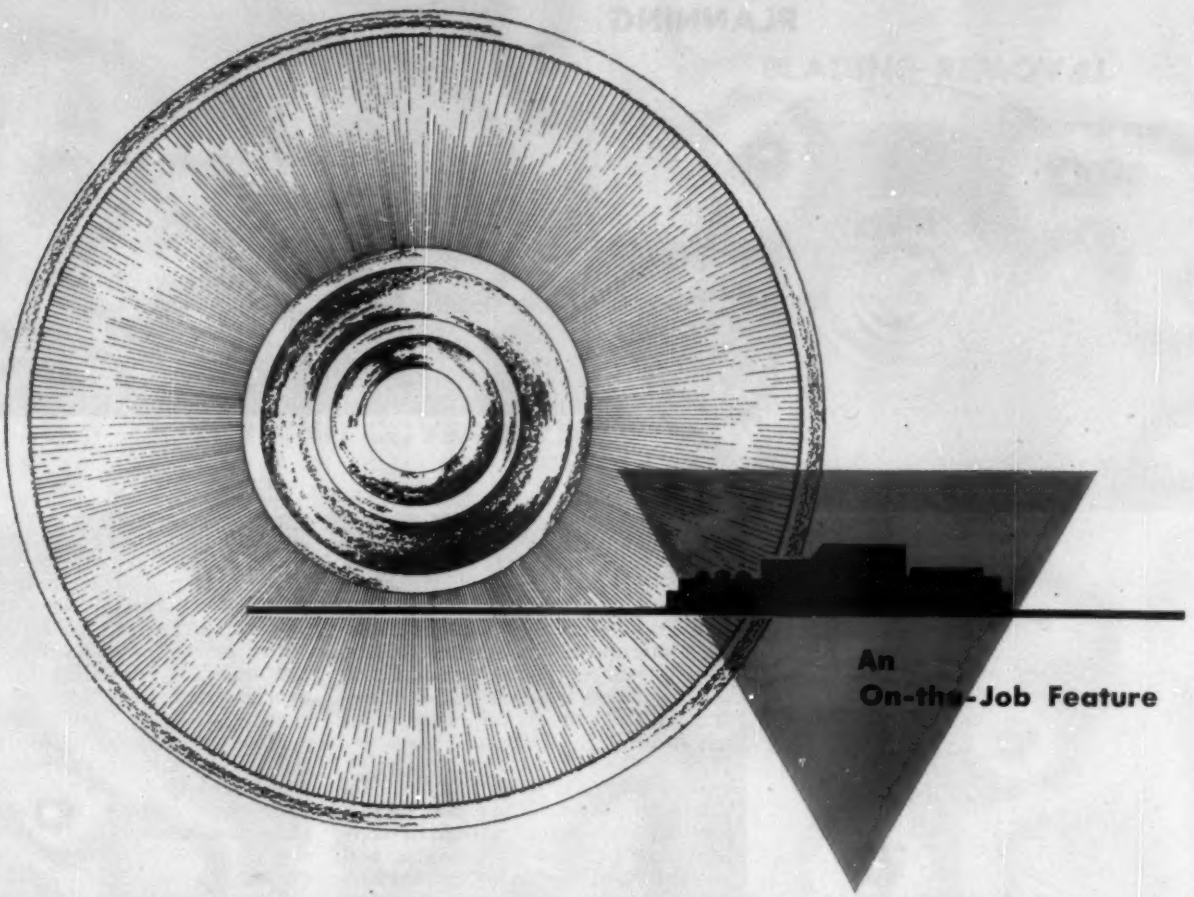
■ Yarway Hi-Lo-Graph Recorder provides not only water level indication, but also a 24-hour recording of water levels. See Yarway Bulletin WG-1830.



■ Yarway Remote Hi-Lo-Alarm Signals—lights or horns—can be placed at any location in plant. See Yarway Bulletin WG-1824.

YARWAY / ***remote liquid level indicators***

For more data circle 551 on Post Card



An
On-the-Job Feature

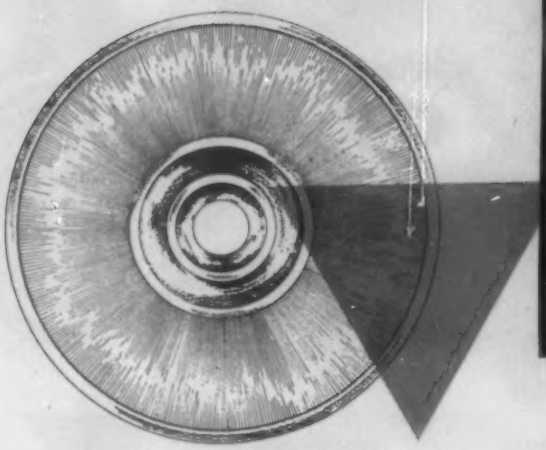
So—You're Going to Overhaul Your Turbine Generator!

NORMAN JONES

The man behind the camera is a POWER ENGINEERING editor. For a month he lived in a steel mill. His camera recorded every step and detail of a planned job. He put them together in a Pictorial Overhaul Manual:— the first of your practical guides to infrequent jobs that must be done right.

- Have you prepared a downtime schedule? How realistic is it?
- Will other departments be able to fit in with your schedule?
- Do you know what handling equipment and tools you will need?
- How much preliminary work can you do to reduce shutdown time?
- How will you avoid blade damage when lifting turbine spindle?
- If some blades need replacing, could you machine the spindle?
- Would you know how to build up an eroded part by metallizing?
- How do you pull generator rotor without damaging the winding?
- How do you check blade clearances? Shaft alignment? Balance?
- What about safety? Fire protection? Vacuum cleaning? etc . .?

PLANNING



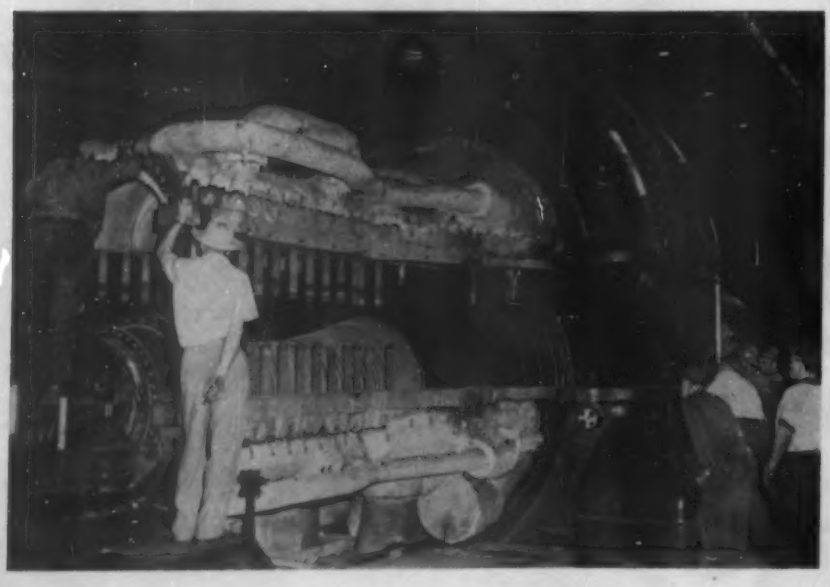
SCHEDULED OVERHAUL on a 25,000-kw turbine generator unit at South Chicago Works of U. S. Steel Corp. was carried out a few months ago. POWER ENGINEERING followed the whole operation step by step, and took dozens of photographs. These will be shown in a series of future articles. Each article will cover in detail an important aspect of the overhaul.

Whatever your own methods, you will be interested in those used on this particular job. Every step of the overhaul was planned in advance, and you'll find in this series the answers to the questions on the previous page. This article is made up of typical photographs selected from each future article to give a preview of the entire series.

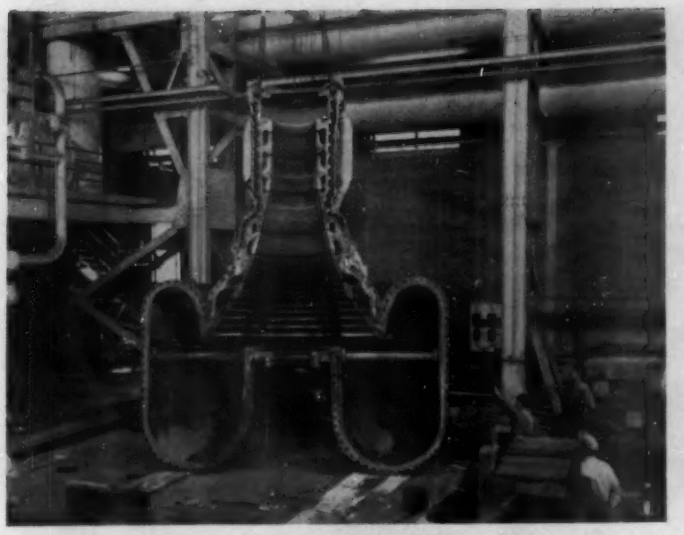
The unit was an Allis-Chalmers 25,000 kw turbine generator. The turbine was a 68-stage Parsons type reaction machine with steam inlet conditions of 450 psi pressure and 750 F temperature. The unit was first started Feb. 3, 1938 and has been out of service for inspection and repair only ten times, resulting in an overall availability factor of 97.7 per cent.

This particular unit overhaul was selected for description because it is a good example of planning and overhaul procedure for a typical industrial turbine generator that has been in service for a long time with a good operating record.

Its last scheduled overhaul was in 1951. The one we are going to describe took place during August 1954, and the unit is expected to run for the next four years without a shutdown. For those not familiar with steel mill operation this means quite literally



LIFTING TURBINE COVER

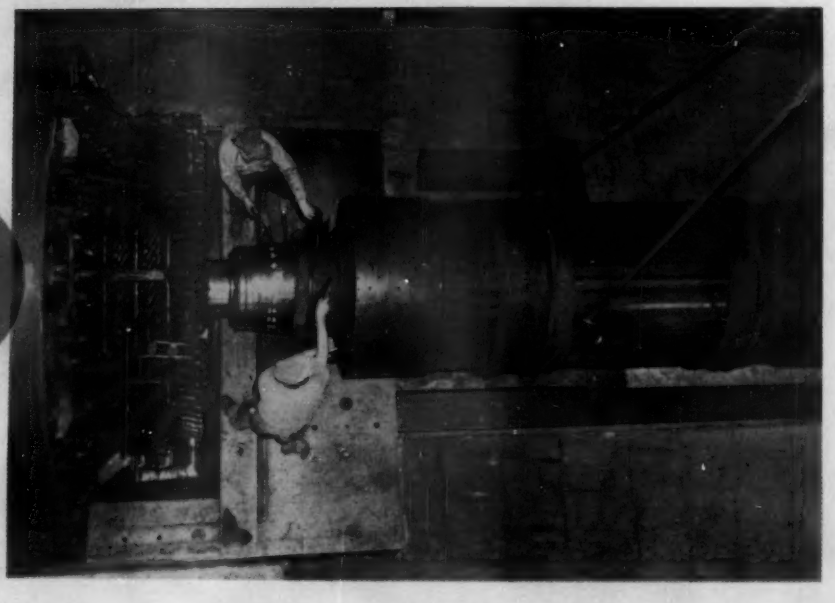


TURNING COVER OVER

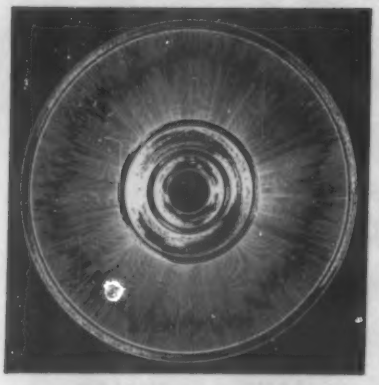
BLADING REMOVAL

METALLIZING
TURBINE SHAFT

PULLING
GENERATOR
ROTOR



MACHINING SPINDLE



running the machine day and night, without stopping, for four years.

In terms of automobile engines, if you take the life of an auto engine as 100,000 miles, you would completely wear out 10 engines before you shut down the turbine for an overhaul. This emphasizes the great care and accuracy with which the machine has to be overhauled and reassembled.

Readers should bear in mind the peculiar characteristics of this type of work. Many rigging and repair jobs need heavier lifts than the parts of a turbine or generator, and many shop operations are carried out to closer tolerances. But the thing that makes this work so difficult is the *combination* of heavy weights with close tolerances.

Turbine spindles and generator rotors weighing 40 to 50 tons have to be moved with clearances of a few thousandths of an inch; and, added to the difficulty of doing precise work with heavy tools and equipment, the job usually has to be done within a close time limit. The price of an error of judgment is measured in thousands of dollars in terms of damage to the

RE-ALIGNING SPINDLE

BALANCING

TIME-SAVING IDEAS

machine, and hundreds of thousands of dollars in terms of lost production if the unit doesn't get back into service as scheduled.

Each of the following aspects of the overhaul will be described in a separate article in future issues:

1. Planning, preparation, scheduling
2. Removing turbine cover and spindle
3. Turning turbine cover after removal
4. Reblading the spindle and casing
5. Metallizing eroded section of shaft
6. Removing generator rotor from stator
7. Setting up for lathe work on turbine
8. Re-aligning the turbine spindle
9. Balancing rotating parts after assembly
10. Miscellaneous jobs done during overhaul
11. Safety measures and time-saving ideas

OTHER OPERATIONS

Fig. 1. Photograph taken from the roof of Consolidated Edison's Astoria station during construction, showing long lines supplying fuel oil to two large boilers

Astoria Gets Fuel Through Mile-Long Line

Long fuel oil pipelines have construction and operating problems not encountered in small lines. Here's an interesting description of Consolidated Edison's experience with an unusually long fuel line

By H. P. ROGERS
Mechanical Engineering Department,
Consolidated Edison Co. of N. Y., Inc.

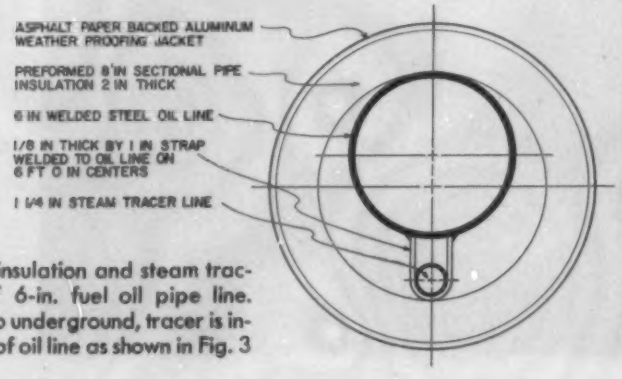

ASPHALT PAPER BACKED ALUMINUM WEATHER PROOFING JACKET
PREFORMED 8'IN SECTIONAL PIPE INSULATION 2 IN THICK
6 IN WELDED STEEL OIL LINE
1/8 IN THICK BY 1 IN STRAP WELDED TO OIL LINE ON 6 FT 0 IN CENTERS
1 1/4 IN STEAM TRACER LINE

Fig. 2. Shows insulation and steam tracing details of 6-in. fuel oil pipe line. Where lines go underground, tracer is installed on top of oil line as shown in Fig. 3

FUEL OIL SUPPLY system for the boilers at Consolidated Edison's new Astoria station is unusual because of the long length of the supply lines. Oil for firing the two 1,370,000 lb per hr reheat boilers is heated and pumped at the fuel oil storage area approximately one mile distant from the station and delivered directly to the burners. The problem of delivering hot "atomizable" oil over this distance was solved by the use of the familiar steam traced line, but the conventional recirculating oil line for maintaining oil temperature was not used because of the long run.

Bunker C fuel oil, which is stored in four 2,000,000-gal earthed-over tanks as delivered by steamer, is heated in suction heaters to 140 F to reduce its viscosity. Turbine-drive centrifugal pumps then raise the pressure to 200 psi to force it through secondary heaters, strainers, meters, the mile-long transmission lines and boiler control valves to the steam atomizing burners designed to operate at 100 psi oil pressure. The temperature at the outlet of the secondary heaters is 200 F and the oil arrives at the boiler essentially at the same

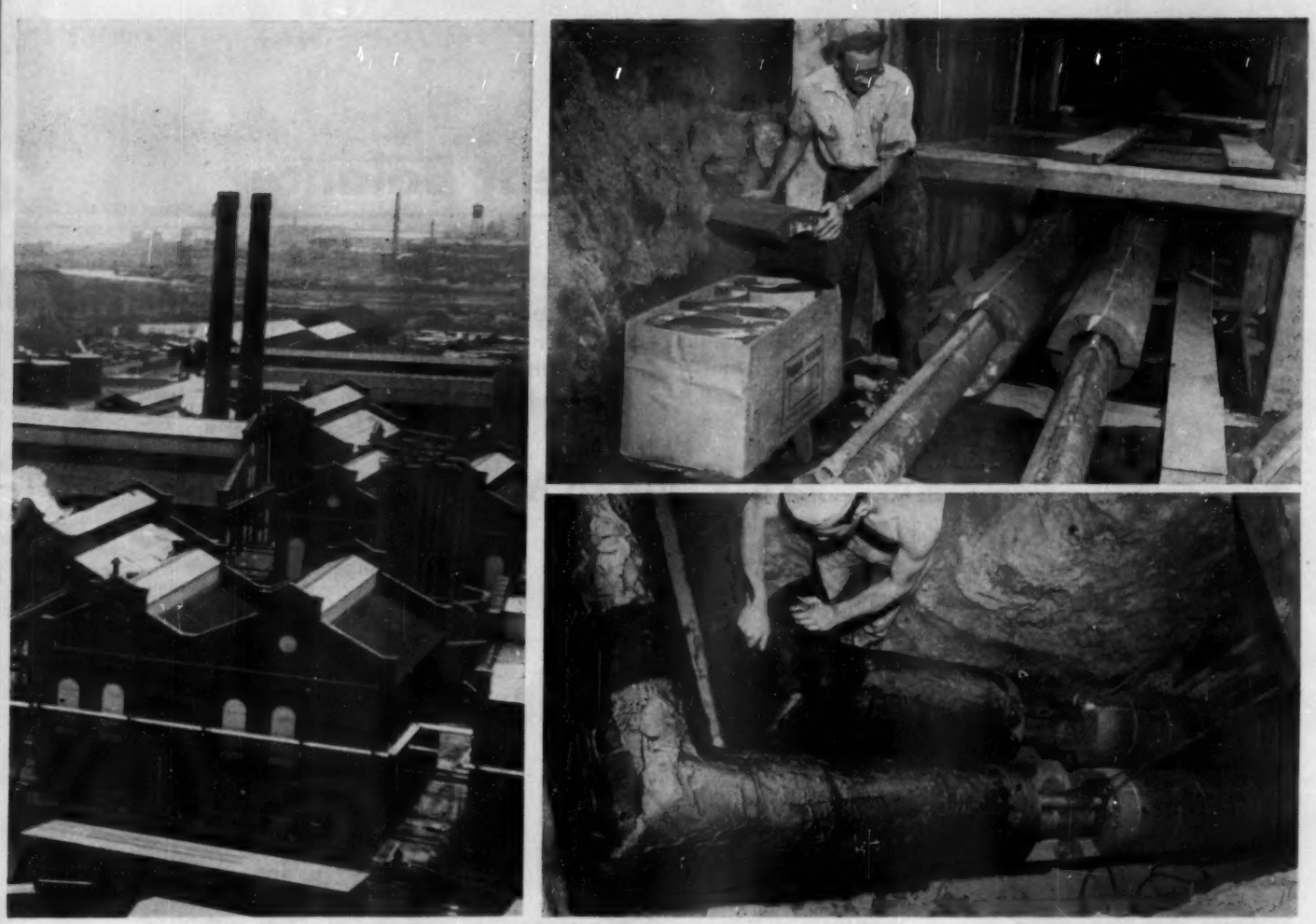


Fig. 3. (Top) Oil and steam tracer lines during construction. (Below) Installing underground section. Oversize elbow insulation permits lateral pipe movement

temperature. Each boiler requires about 200 gpm at capacity.

To make sure loss of fuel supply will not affect both boilers, each one has a separate pumping and heating system and supply line. Thus two 6 in. oil lines were run from the storage area to the generating station. At the station a valved off cross-over is provided so that for outage of one of the lines both boilers may be fed by the remaining line at which time the pumping pressure is increased.

The all-welded steel lines are suspended overhead on structural steel supports spaced approximately 30 ft apart. There are numerous U bends to allow for expansion of both the oil line and the tracers. At a point 450 ft from the station the traced lines go underground to avoid interference with high voltage transformers.

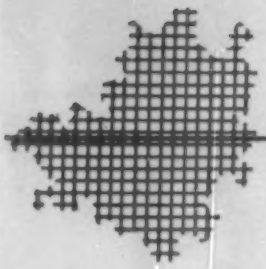
Figure 2 shows the method employed for supporting the overhead line tracers. Using this arrangement it was just possible to envelope the 6 in. oil line and 1¼ in. tracer line with standard 8 in. preformed sectional pipe insulation. The insulation used proved amply rigid to maintain its shape despite being supported only at its tangent point with the oil line. At the expansion U bends larger sized preformed insulation was used to permit the tracer line to expand without the 1¼ in. elbows punching through the insulation. The tracer supports welded to the oil line at these locations was modified to permit transverse sliding. The aluminum weather-proofing jacket was installed without sealer at the girth joints as it was felt that the slight moisture penetration would evaporate quickly at the surface temperature of the insulation. Insulation at the elbows was given a troweled coat of asphaltic material. No attempt was made to apply the aluminum jacketing to surfaces of compound curvature.

Original plans for the insulation of the steam-traced underground portion of the run called for the use of 3 in. thick cellular glass, a material that is impervious to moisture. In order to waterproof the joints a ⅛ in. thick coating of asphalt sealer was applied over the insulation followed by a glass fabric, another ⅛ in. thick coating of sealer and a three ply asphalt felt with sealer over the laps.

During construction it was found necessary to lower one portion of the underground lines considerably in order to clear existing electric duct banks. As a result for some 200 ft the lines were below the water table. To insure against possible breaks in the waterproofing in this portion of the installation, a 16 in. I.D. asbestos-cement conduit was substituted and slid over the cellular glass covered pipe lines. Joints in the asbestos-cement pipe were caulked and encased in concrete.

Wherever the lines passed directly under electric ducts additional layers of cellular glass insulation and precast slabs of insulating concrete were installed in order to minimize any heating effect of the oil lines that might affect the current carrying capacity of the underground electric cables.

Allowance for expansion of the long straight portion of the underground oil lines and their tracers was provided by anchoring them at one end and permitting them to expand into a deep pit constructed at the other end 300 ft away. The tracer lines for the underground portion were positioned *continued on page 121*



Graphical Boiler Heat Balance

By PAUL J. GROGAN *

Each factor in the boiler heat balance, if not done frequently, is a potential stumbling block for the engineer. This article is the third work-saver prepared by the author, reducing calculations to manipulations of charts. Other heat balance articles will follow

3. Loss Due to Moisture in the Fuel

ALL NATURAL fuel deposits contain a certain amount of *free* or *surface moisture*. The limits to this moisture are the absorptive capacity of the particular fuel and the conditions of equilibrium of moisture content with respect to the surroundings. Thus, the moisture content of a fuel may vary from a mere fraction of a percent in natural gas to a per cent or two in petroleum fuels, and to five, ten, or even twenty percent in certain coals. Peat, wood, and most refuse fuels may consist of fully fifty per cent surface moisture.

Other forms of moisture released in the combustion of natural fuels will be discussed in later articles.

Handling and processing fuels generally results in a significant change in the surface moisture content. As a result, several forms of solid fuel analysis have become common. The so-called *as-received*, *moisture-free* or *dry*, and *as-fired* bases of coal analysis are merely attempts to treat the variable per cent of surface moisture in a logical manner.

Moisture in a commercial fuel is a factor in the market price of the fuel inasmuch as handling and transportation costs are generally determined on a weight basis. Water, like ash, may be considered as so much dead weight where handling and transportation are concerned.

Moisture may have further good or bad effects upon the fuel with respect to car unloading in cold climates, deterioration in handling and storage, the auxiliary power consumed in pulverizers, or the fuel bed characteristics in stoker firing. Apart from all of these, there is the definite disadvantage of having heat removed from the furnace by the superheated vapor which results from the evaporation of the surface moisture in the fuel. This latter item may be closely evaluated after deriving a mathematical expression for its magnitude.

For purposes of this discussion, the temperature at which fuel is fired into the furnace is taken to correspond to the temperature of the combustion air. This will be especially true if the fuel is stored in a furnace room bunker for some time before firing and then spends more time in the coal feed system as it approaches the burner or combustion zone.

Moisture in the fuel will begin to evaporate rapidly when the fuel is thrust into the area of combustion. Surely, this evaporation becomes complete at or below 212 F. An average between furnace room temperature and 212 F, approximately 150 F, is assumed for this discussion. Recalling the specific heat of the liquid over this temperature range as being near unity, q_1 (the heat to the liquid) is:

$q_1 = (150 - T_{air})$, where

T_{air} = combustion air temperature, degrees F

The latent heat of vaporization at 150 F is given by Keenan and Keyes as:

$q_2 = 1{,}008$ Btu per pound

Superheat (q_3) of the vapor, at the flue gas temperature (T_{gas}) must be added to q_1 and q_2. For the range of gas temperatures normally encountered in power plant practice and for the low partial pressure of water vapor in the flue gases, a specific heat of 0.46 Btu per pound per degree F applies. Therefore:

$q_3 = 0.46(T_{gas} - 150)$

Heat carried away per pound of moisture may be evaluated by adding the three parts:

Heat to the liquid, $q_1 = (150 - T_{air})$

Latent heat, $q_2 = 1{,}008$

Superheat, $q_3 = 0.46(T_{gas} - 150)$

When the terms are collected and the pounds of moisture per pound of fuel are considered, the heat loss per pound of fuel becomes:

$Q_m = W(1089 + 0.46T_{gas} - T_{air})$, where Q_m = loss due to moisture in fuel (Btu per pound of fuel); W = decimal fraction of moisture (pounds per pound of fuel); T_{gas} = flue gas temperature (degrees F); T_{air} = combustion air temperature (degrees F).

The preceding equation is solved graphically on the construction which accompanies this article.

Working Examples

Example 1: Assume a fuel contains 10 per cent moisture, the combustion air temperature is 100 degrees F, and the furnace gases cross the last heat transfer surface at 300 F.

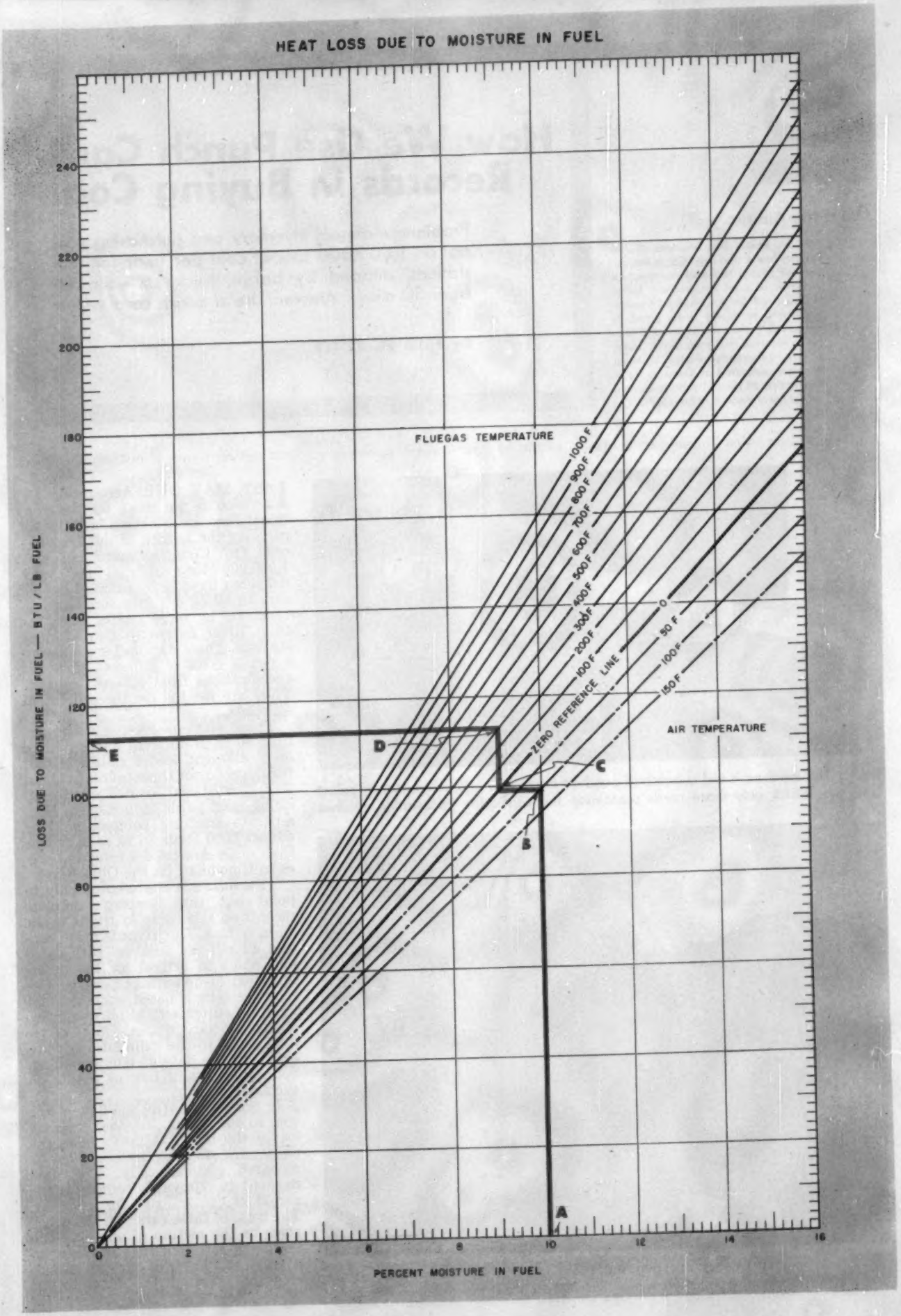
Solution: Enter the chart along the lower ordinate at 10 per cent moisture in the fuel (Point A). Move vertically until intersecting the 100 F air temperature line (Point B). Shift to the left along a horizontal line until intersecting the "zero degree reference line" (Point C). Move vertically again to the 300 F gas temperature line (Point D). Read the answer, 113 Btu per pound of fuel, along the vertical scale (Point E).

Example 2: Assume a fuel contains 5 per cent moisture, the combustion air temperature is 50 F, and the outlet gas temperature is 500 F.

Solution: Enter the chart at 5 per cent moisture in the fuel. Move vertically until intersecting the 50 F air temperature line. Move left to the "zero line" and up again to the 500 F gas temperature line. Read the answer, 63 Btu per pound of fuel, along the left-hand vertical scale.

NOTE: There is an approximation in the graphic solution as it is devised here. The construction is nearly exact for air temperatures of 60 F. Temperatures above or below 60 F result in minute differences between graphical and mathematical solutions. These differences are well within one per cent for the range of air temperatures likely to be encountered.

* Chairman, Department of Engineering, and Director, Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.


HEAT LOSS DUE TO MOISTURE IN FUEL
LOSS DUE TO MOISTURE IN FUEL — BTU / LB FUEL
PERCENT MOISTURE IN FUEL
FLUEGAS TEMPERATURE
AIR TEMPERATURE
ZERO REFERENCE LINE
1000 F
900 F
800 F
700 F
600 F
500 F
400 F
300 F
200 F
100 F
0
50 F
100 F
150 F
A
B
C
D
E
0
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About the Author

Fred M. Reiter, Fuel Engineer of The Dayton Power and Light Co., is the author of many technical articles. An authority on coal procurement, Reiter has been with Dayton P&L for 28 years. He served in World Wars I and II; for service in the Mediterranean Theater he received the Order of the Crown of Italy, Commander. He is a chemical engineer, educated at Carnegie Tech. This is first of several articles on coal procurement methods at Dayton P&L Co.

How We Use Punch Card Records in Buying Coal

Problem: Maintain inventory and purchasing control on 1,000,000 tons of coal per year for four stations, shipped by barge, truck, six railroads from 50 mines. Answer: Use a punch card system

By FRED M. REITER

Fig. 1. This machine is fed a batch of punched cards and will automatically select from that batch only those cards containing the particular information desired

Fig. 2. Into this machine go the punched cards selected by the collator above. The printing machine, right, then types final report from the data on the cards

LAST MAY OUR Accounting Division began using our International Business Machine facilities for carrying the burden of our coal records. Our Company purchases over 1,000,000 tons of coal per year, delivered directly by railroad hopper cars to all of our four separate stations, or by large trucks from the Ohio River barges to two of these stations. These stations burn different types of coals of different sizes and specifications from different sources. They are located on three different railroads.

These stations receive their coal from 30 to 50 different mines located on 6 different feeder railroads that turn over to our three railroads about 2000 cars of coal for delivery to our sidings and yards each month. Four separate trucking companies bring almost 2000 loads to us each month from other sources delivered in barges to Cincinnati on the Ohio River.

This situation is presented only to point out that keeping complete records on this complex traffic is not an easy task. Our records must contain all rail car numbers with dates and hours of arrival for the determination of demurrage periods. Demurrage time is based upon the first 7:00 A.M. after arrival on our interchange or yard tracks. Dates of release back to the railroads, as indicated by the date of our unloading, determine the debits or credit on each rail car.

In order to control the flow of the coal to our plants, the date each car leaves the mine, as taken from the daily mine shipping notices, must be recorded systematically. The date received in our yards completes the period of "in transit" for each car. The total of these cars "on the way" gives us the picture of our pipe line flow. We estimate that it takes an average of 5 days for our coal cars to come by rail from the mines to our yards. Hence our pipe line or "in

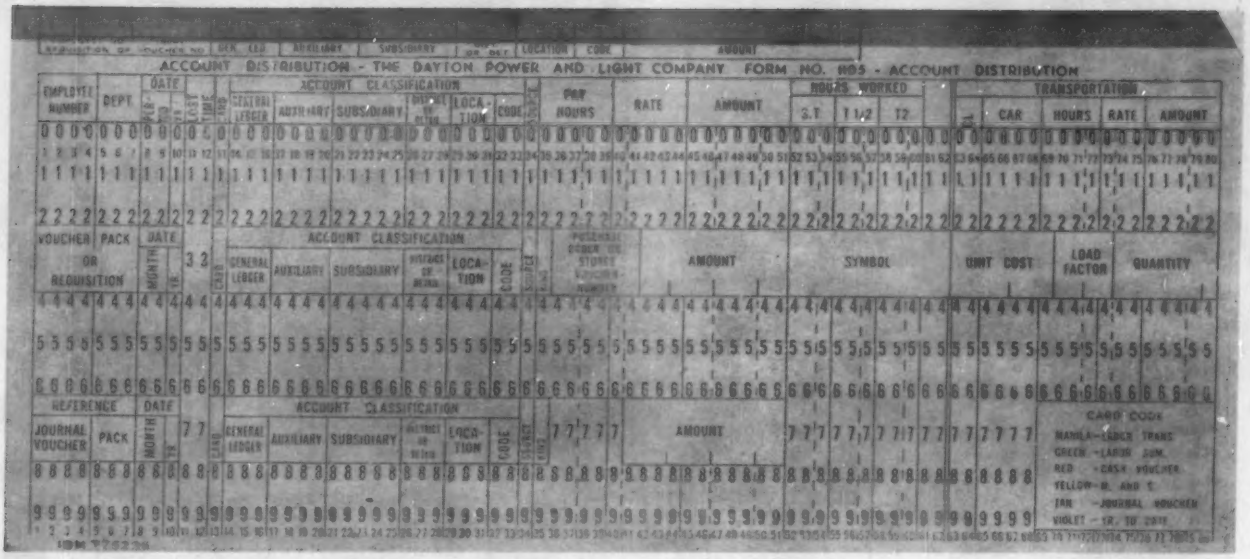


Fig. 3. Information is stored on this card by punching holes in proper places. Machine can "read" holes and print data

transit" should hold 5 days' supply for each of our stations.

We must return our empty cars to the railroad interchange tracks outside our station property in order to obtain the release from demurrage responsibility. We use our own locomotives for this purpose. The individual car numbers are automatically removed from the machine records, as of the dates on which they are unloaded and delivered to the interchange tracks, by means of the punch card operations, daily. From all of these date records, we determine our "supply logistics" each day: how much coal we have in transit, how many cars are in our own yards, which cars they are, whose they are in terms of car numbers for our chemists to select for sampling, which cars to unload to earn the most credits and the least debits, and many other facts and compilations that we must derive from the basic recorded information.

Weights of car loads, sizes of coal, prices, freight charges, and numerous cost and procurement items must be recorded daily for checking the proper deliveries in tonnages, prices, costs, properties, etc.; for the payment of coal and freight bills; and for any and all accounting and statistical purposes required in the complex process of a large utility. Where all these figures affect consumers of our product — electricity used by the public — and where our records and operations are subject to inspection by internal and external auditors or by regulatory bodies, accuracy and completeness are essential. From these daily records come our many weekly, monthly and annual statistical reports, as required by different departments.

It is not difficult to visualize the vast amount of detail that must be maintained, and what a job this must be with hand recording. It is not hard to picture the work and sagacity re-

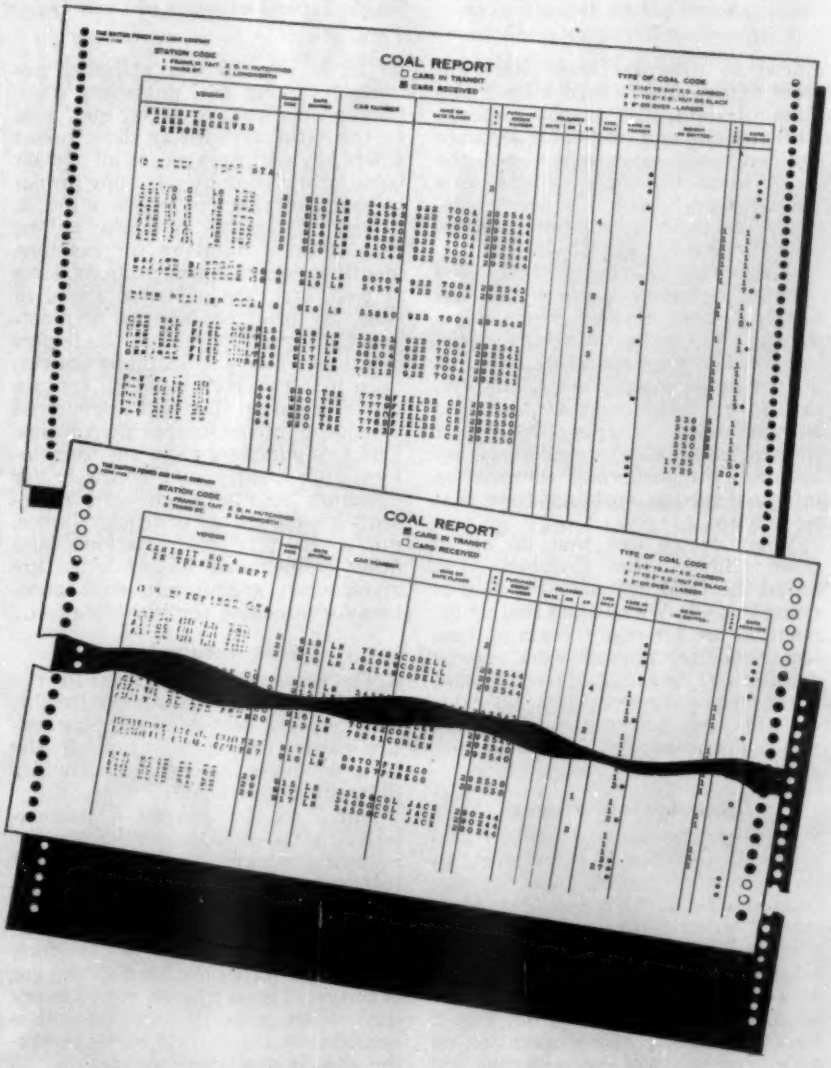


Fig. 4. These two printed reports are of particular interest to the Fuel Department. The lower report shows all cars in transit, tabulated by shipment, vendor, mines, and dates. When a shipment is received, it is transferred to the "Cars Received" record sheet (upper) where all pertinent information on each shipment is recorded

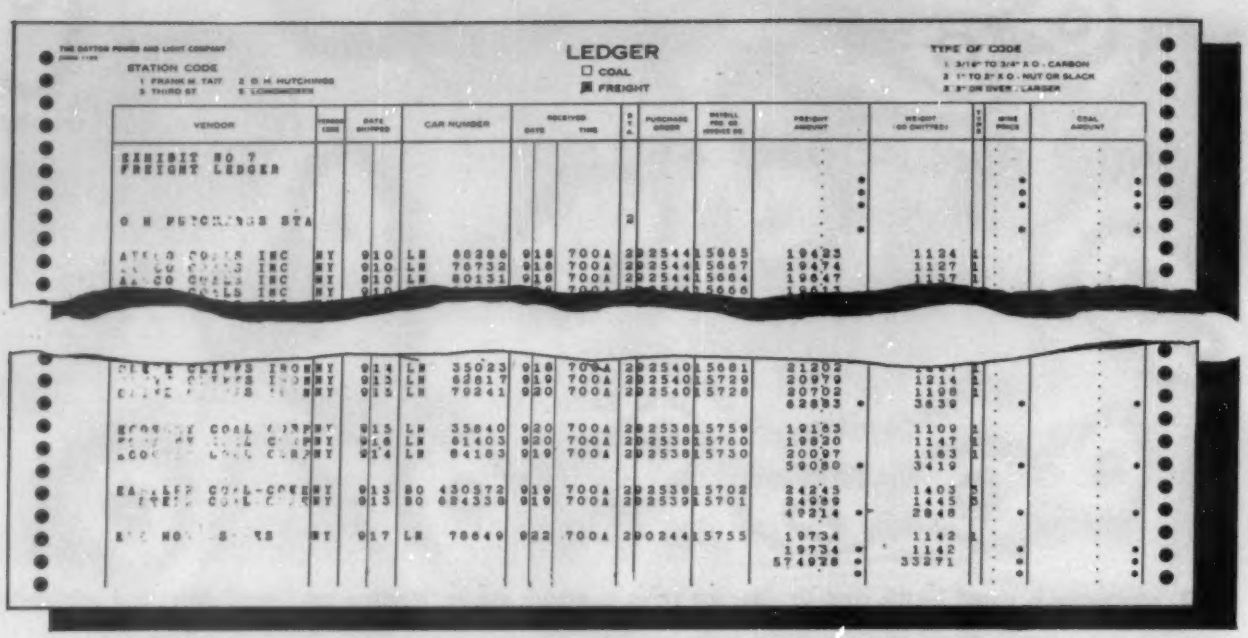


Fig. 5. Typical example of Daily Freight Ledger shows car numbers, weights, etc.

quired to interpret these hand-entered figures and to evolve from this mass of data, the precise reports, statistics and end results for separate shippers, bill payments, and the many items mentioned above. Is a vendor maintaining his proper delivery schedule, over or under shipping? Is he shipping nut-slack or carbon size coal to the right station? What is the weekly status of the various coal storage piles? There are a myriad of questions constantly arising from the plant operators, accounting personnel, management, shippers, and so on, that must be answered without delay. It takes a SYSTEM to gather, collate, interpret and reassemble the basic daily information into final specific working figures that we can use.

What device can best do all of these things? Our Company has found the IBM system a big help in doing this job. We had had this equipment in use for many years on customer billing, payroll work, stores accounting, financial statistics, and other large volume operations. Adding the coal procurement program was just another job for our system and our accounting personnel.

How System Works

It might be best to explain this system of ours briefly by referring to the illustrative sheets that emerge from the IBM machines. Two illustrative photographs may serve to portray their working: Fig. 1 shows a batch of punched cards being fed to a machine for selecting whatever specific data may be desired; Fig. 2 shows the final printing operation on a continuous roll of specially punched paper selecting its information from the batch of cards fed in at the left-hand machine.

The process starts out by having all basic information, shipping notices, receiving and unloading slips, freight bills, coal invoices, etc., sent to the IBM accounting department where key punchers record all of their basic information by punching proper holes in cards such as shown in Fig. 3. Copies of monthly purchase orders, lists of code numbers for machine identification of mines, stations, sizes of coal, etc., are provided ahead of time. By prior conferences or meetings among all concerned, the papers mentioned above — shipping notices, bills, invoices, etc., must all contain the information that will be required ultimately in the final printed forms. The key punchers must get their information clearly and concisely for optimum results. Each card represents a separate car or truck. Names, mines, sizes of coal, stations, and other items with longer titles are given short appropriate code numbers for punching for identification.

Cards Accumulated

The cards are accumulated for the duration of each month as freight, invoice, coal received, shipping notice cards. Proper collation of the cards produces the reports desired by different departments.

Our Fuel Department is particularly interested in, and receives, the following reports (see Fig. 4) printed from the cards:

1. Daily Cars in Transit report on which, as mentioned before, is tabulated all shipments by vendors, mines, and dates. As long as the car is active, it is carried on record every day. When a car is received and is recorded at the station on its receiving slip, it disappears from this "In Transit" report. We know how many cars, which ones, whose, what purchase orders apply, etc., and the totals. Copies of this daily report go to our laboratory and coal receiving men to advise them of the identity of all incoming cars.

2. The Cars Received sheet adds more detail, receiving data, dates, totals, etc. Truck identifications appear with their weights. The cars in our yards are shown. When a car is unloaded it disappears from this report and total demurrage time, debits or credit figured. Debits and credits are accumulated daily from this report. Copies of the report go to our traffic and other offices interested in this information.

3. The Daily Freight Ledger is shown in Fig. 5. This report adds freight waybill data, weights, freight charges, etc.

These three composite sheets supply us with the necessary daily information for our operations, as well as for the operating and purchasing departments, as basic forms. From the accumulated cars weekly and monthly, station and inventory coal reports are run off. Monthly coal ledgers showing prices, total billing, etc., by separate vendors and stations, or in any manner desired, are supplied. Monthly station coal reports are run off from these punch cards for various special reports and analyses, for statistical and other departments which need such information.

Adapt Own System

It is the purpose of this article to merely describe "a system" of doing this work mechanically, not to favor IBM methods. Other arrangements or facilities or equipment may do equally well. It may depend upon what equipment any particular plant or firm already has in operation for accounting work. It then becomes a question of economics and the amount of information required.

Flexidyne — New Dry Fluid Drive

In this constant torque drive, flow charge of small spherical steel shot is designed to act like a fluid, transmit power from driver to driven machine. Permits smaller motors and controls. Now sized up to 30 hp; can be built for much larger capacities

NEW DEVELOPMENT in industrial power transmission, called Flexidyne, and described as a dry fluid drive, has just been announced. Based upon a completely new principle, it is designed to handle difficult starting and reversing problems, and to give a protection against shock and overloads. At normal operating speeds it does not slip. At the same time, in the case of an overload, it is slippage that gives protection.

It is claimed to have wide application for industrial drives involving heavy inertia and shock loads on such equipment as refrigeration and air compressors, diesel engines, conveyors, cranes, crushers, and many process machines.

The Flexidyne Drive is made up of a housing, inside of which a rotor is free to turn concentrically. Between the two are fine particles of spherical steel shot, called the flow charge, which acts very much like a fluid. The flow charge transmits power from the housing to the rotor. This flow charge is sealed in, has a high density and can stand relatively high temperatures. Here's how it works:

The motor is connected to the housing, and starts it turning at no load. The flow charge is thrown to the circumference of the housing, is compressed by centrifugal force, and revolves with the housing.

The rotor, connected to the load, is started and accelerated by the friction and wedging action of the revolving flow charge.

Rotor and housing reach identical speeds — the Flexidyne operates with zero slippage between motor and load at normal running speeds.

In case of an overload, before damage is caused, the Flexidyne rotor slips relative to the housing, overcoming the friction and wedging action of the flow charge. A thermal switch, which automatically cuts the electrical circuit if an overload persists, is available as optional equipment.

Amount of the flow charge determines the torque capacity. Because it is easy to vary the amount of this charge, the drive will give the exact starting torque needed for anything from the smoothest to the fastest start.

Accurate overload protection claimed, for the Flexidyne can be set to slip at anywhere from as low as 20 per cent over full load torque to as high as peak motor torque. During starting and overload periods the current draw is at a minimum because, with the standard Flexidyne setting, the motor is never pulled down to less than 90 per cent of synchronous speed.

This drive is built to produce constant torque for a given input speed, regardless of percentage of slip between rotor and housing (which only occurs during starting or overload).

Flexidyne permits the use of smaller, cheaper motors and controls, with greatly reduced current demands and improved power factor.

Two lines will be available — (1) Flexidyne Drives for convenient mounting directly on motor shafts and adapted for Taper-Lock Sheaves, and (2) Flexidyne Couplings, with Taper-Lock Bushings for straight line drives. First to be offered from stock will be four sizes, rated at 3 to 30 hp at 1800 rpm. Other sizes will follow.

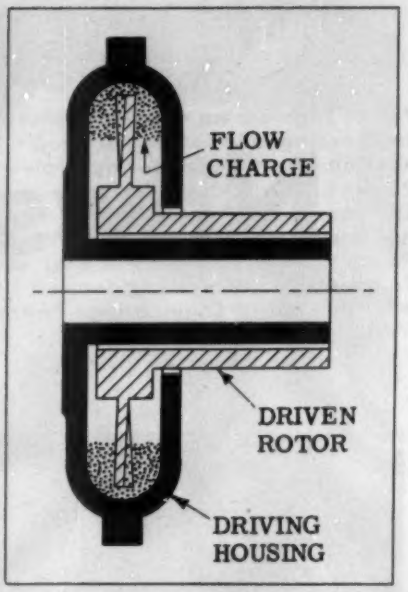


Fig. 1. Principle of new drive:—prime mover rotates driving housing, centrifugal force throws flow charge to circumference, and it transmits power by friction to the driven rotor and machine

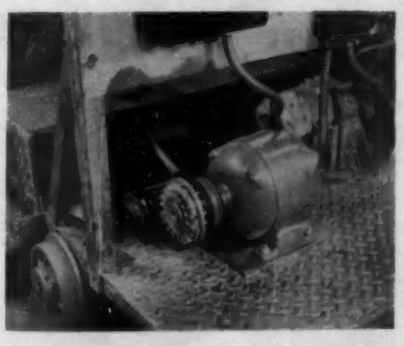


Fig. 2. Flexidyne picks up power from ¾-hp, 440-v, 1150 rpm squirrel cage motor, delivers it through V-belt to drive foundry cart carrying 2 tons

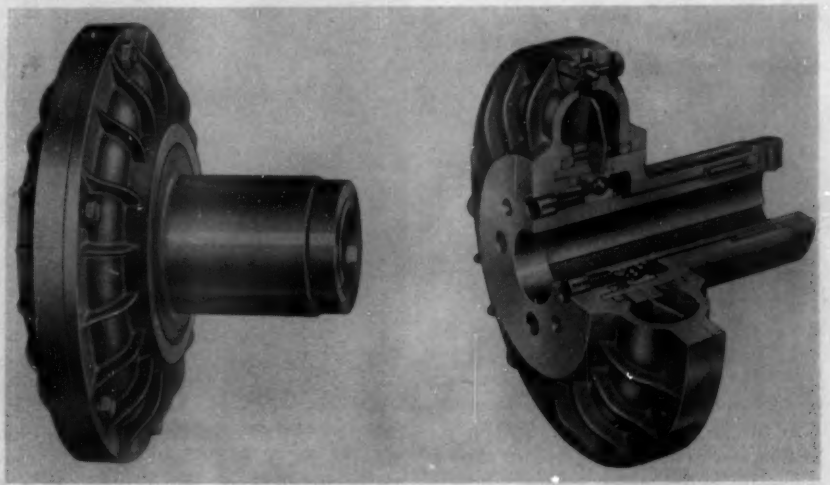
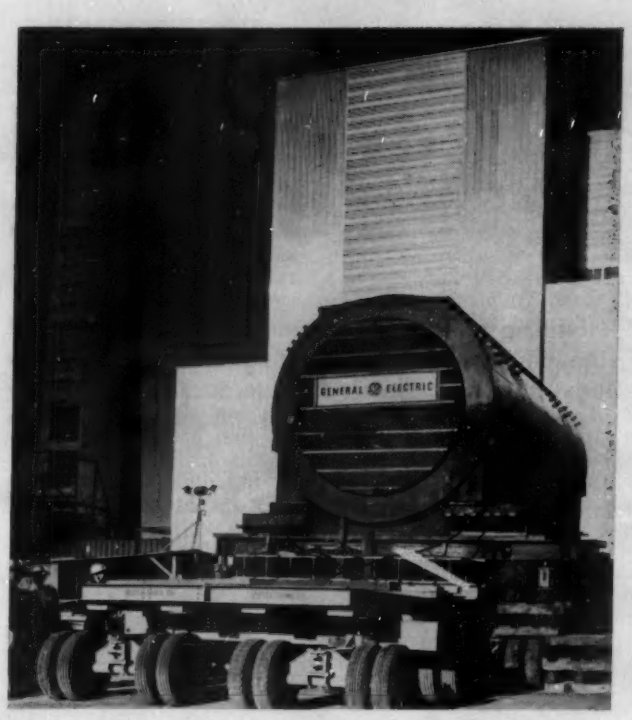


Fig. 3. Complete assembly, left, and cutaway view of new Flexidyne drive

For more information on this drive, write The Editor, or write Flexidyne on the prepaid post card you will find elsewhere in this issue and mail it in to us.

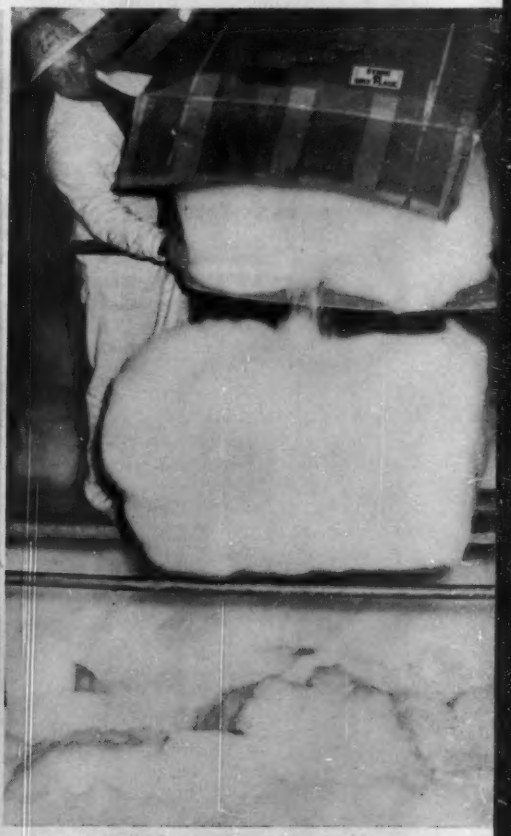
Power Engineering • Power Engineering • Power Engineering •



MORRO BAY power station of the Pacific Gas & Electric Co. receives its new 150-mw generator stator after a harrowing 3100-mile trip from Schenectady, N. Y. The unit was designed with right-of-way obstructions in mind, and over two years' preparations preceded its shipment. The last 240 miles were through R.R. tunnels and by highway

WATER FLOW patterns are used to study the effects of intake tunnels for circulating water at the new Westinghouse steam division laboratory. The test circuit provides controlled conditions for determining the effects of the many variables that enter the design of circulating water pumps and the hydraulic ducts and conduits for handling models to 3000 gpm

LARGE steam turbine-generators are the subjects of this serious conversation. The speaker (left) is Glenn Warren, head of G-E's Turbine Division, and the listener is Dr. Theodore von Karman, father of modern aerodynamics. Von Karman was attending talks on the application of aerodynamics to turbine design



HOT CLOUDS—at least these fibrous glass filters will be after absorbing Hanford's atomic wastes from exhaust gases. Filter is 7 ft deep, 56 ft long

Handling Heavy Fuel Oil . . . Is an Art

Handling fuel oil can become a dirty, messy job if the oil pumping and heating system is improperly designed. Here's how to tackle preliminary design considerations for a trouble-free system

By ALMONT A. KOEPF

Senior Facilities Engineer, Boeing Aircraft Co.

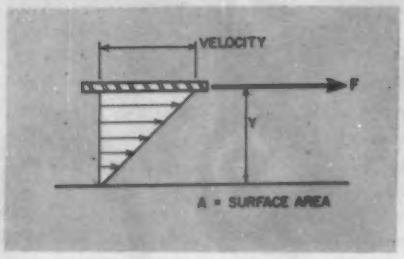


Fig. 1. Diagrammatic representation of fluid shear resistance between plates

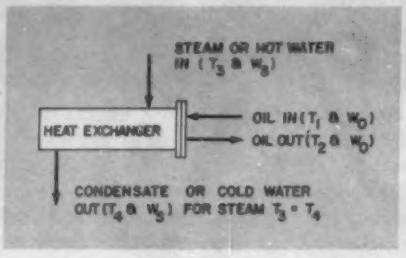


Fig. 2. Relationships of temperatures in the fuel oil system heat exchanger

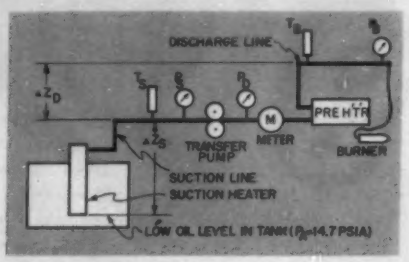


Fig. 3. Basic considerations in pumping layout shown here. Explanation in text

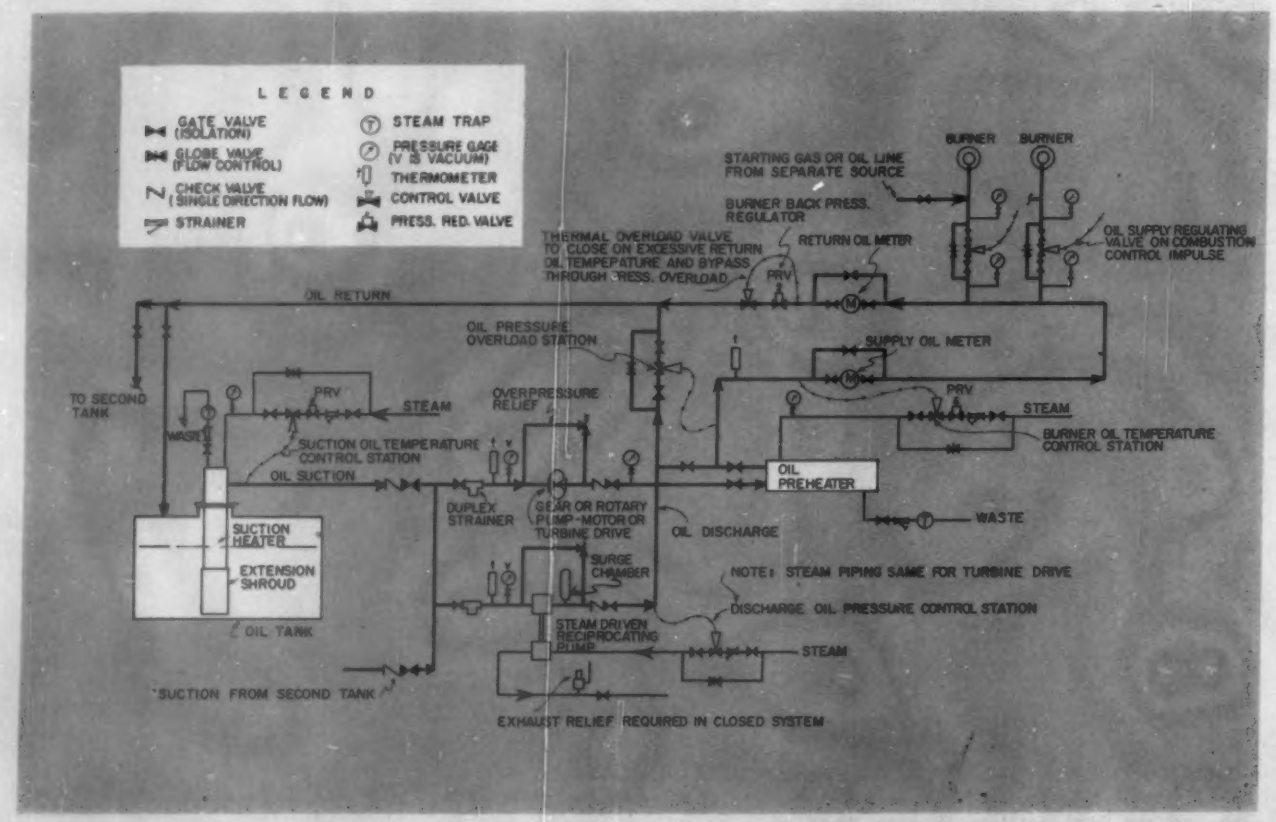


Fig. 4. Typical heavy fuel oil system in diagram uses steam heaters at source of storage and near burners. One improves pumpability, other aids atomization

HEAVY FUEL OIL handling and burning is an engineering art. This article is intended as a primer for the engineer designing his first system or the operator working his first system, and as such will attempt to bridge the gap between design and operating views.

Heavy fuel oil is defined as Commercial Standard CS-12-38, oil number 6, or, as commonly known, Bunker "C". It represents the last major marketable refinery end product. As such, its specifications are few as determined by A.S.T.M. methods. The minimum flash temperature is 150 F. The viscosity must not exceed 300 Saybolt Seconds Furol (SSF) or be not less than 45 SSF when measured at 122 F. Moisture and sediment shall not exceed 2 per cent, with no limit on sulfur. The significance of these values follow.

The engineer would be wise to contact the local suppliers for specific data on the actual product to facilitate proper design to obtain satisfactory handling and combustion. In cases where the source of supply is not known, the handling system must be designed for the minimum flash point and maximum viscosity.

Flash point represents the temperature at which the oil will commence to vaporize and ignite at atmosphere pressure. Proper combustion requires that a substantial percentage of the oil vaporize upon ejection from the burner; an ejection temperature of 160 F to 200 F gives best results. This corresponds to a viscosity of 100 to 150 SSU. Do not attempt to light off a boiler with oil temperature at less than 160 F.

Shear Resistance

Viscosity represents the fluid shear resistance to flow of the oil. To develop the viscosity mechanism, consider the drag of one plate across another with an oil film separation (Fig. 1). The force required to pull the upper plate, considering low oil velocity, is the product of shear and area, or: $F = SA$. This can also be stated as: $F = (\mu V/y)A$, where $S = \mu V/y$. In this case, shear is equated to velocity and the inverse of the distance between plates by the proportionality constant, μ. The constant, μ, is the "absolute" viscosity, and is measured in units of poise (dyne seconds per cm^2). A more convenient unit is the centipoise, or 1/100 poise.

Specific gravity, and hence density, of the oil is defined in terms of degrees API. The equation is: deg API = (141.5/sp gr at 60 F) – 131.5. From this, Bunker "C" weighs approximately 8.5 lb per gal.

A second basic viscosity unit is the "kinematic" viscosity, ν, and is defined as the absolute viscosity, μ, divided by the density ρ. The units of kinematic viscosity are the stoke and centistoke (1/100 stoke) or cm^2/sec. The kinematic viscosity is readily determined by means of the Saybolt Viscosimeter consisting of a measured volume reservoir with a calibrated outlet orifice. The time required to fully empty the reservoir through the orifice is registered as Seconds Saybolt Universal (SSU). Figure 3 shows the temperature-viscosity relationship for Bunker "C" and other oils. For extremely viscous oils, the Saybolt Furol Viscometer with a large orifice is employed with units of Seconds Saybolt Furol (SSF). The kinematic viscosity in centistokes for a given temperature can be determined from:

$$\nu = 0.220\ (SSU) - 135/(SSU)$$

$$\nu = 2.16\ (SSF) - 60/(SSF),$$

and the ratio of SSU to SSF is approximately 10 to 1 for a given viscosity. Figure 5 shows the viscosity-temperature relationship.

Moisture, sediment, and sulphur contribute on a secondary basis as main causes for fouling the system. The primary concern with these foreign elements is in the furnace and beyond the scope of heavy oil handling.

Handling Fuel Oil

Fuel oil handling consists essentially of five phases: storage, heating, pumping, burners, and controls. Obviously operation of all phases are interlocked but still the breakdown is suitable for analysis.

Facilities for storage are generally dependent upon quantity, available space, and distance from consumption. Bulk commercial deliveries must influence design considerations and the designer should determine whether delivery shall be by tank truck (up to 3000 gallons), rail tanker (8000 or 10,000 gallons) or barge (84,000 to 630,000 gallons), realizing that larger bulk deliveries come at lower cost.

The storage capacity should be at least that required for delivery plus three or four days maximum capacity use. The designer should also attempt to provide at least three weeks supply at maximum consumption in remote areas, two weeks in rural areas, and one week in urban industrial areas.

In some cases where the sources of supply are readily available, multiple methods of transportation at hand, and space is at a premium, three or four days maximum consumption storage is not uncommon although not particularly advisable. An additional feature of severity of weather or critical nature of fuel availability might prompt the designer to provide additional storage above a minimum. The two types of storage are above ground and underground. Details of structural and safety requirements are dictated by the local fire ordinances and the National Board of Fire Underwriters pamphlets.

The technical requirements for storage must be established before evaluating above-ground versus underground storage. The above-ground tank farm system has definite advantages: it is economically suitable for large storage at low cost; the pumping problem is minimized; and all equipment is readily accessible for maintenance. Plan on placing an earth or concrete dyke around the farm to contain the total volume of oil with about one-third additional freeboard.

The disadvantages of above-ground storage are generally that considerable area is required for the farm, and the space available, if any, must, by local codes, be remote from the consumption. To allow storage in confined areas and close to consumption, it might be advisable to install underground tanks. The capacity of such tanks, when steel, is seldom over 25,000 gallons each. Concrete tanks are best for large capacity. Sometimes it is advisable to have a major remote storage area with one- or two-day tanks close to the consumption. This would permit storage at optimum cost with immediate-use oil supplied close to the boiler house.

Fuel oil heating is utilized for two purposes. The first purpose of heating is to facilitate pumping as the viscous resistance of the oil decreases rapidly as the temperature increases. The second purpose is to heat the oil to atomizing temperature for combustion. The conventional method of supplying the heat is through a suction heater at the source of storage, and a preheater close to the burners. Steam, hot water, and electricity are the principal sources of heat. Selection depends primarily upon cost, reliability, and availability. Each has features sufficiently unique to warrant discussion.

Steam should normally not be used above 25 psig as the surface temperature will overheat and carbonize still or slow moving oil too readily. The condensate out of the heaters should be piped to waste as the chance of transmitting oil to the generation system is too great a risk for the possible economy otherwise attained. Circulating hot water is often used as an intermediate heat source between oil and steam or electricity. This heat source provides protection against contamination of the steam and over-heating of the oil. Electricity is generally expensive but provides an excellent means to facilitate a cold start. Where cold starts are common, electric heat in series with steam or hot water is proving quite satisfactory.

Heating the Oil

Normally only enough heat should be supplied at the suction heater to allow easy movement of the oil. This generally requires heating to between 90 F and 130 F, resulting in a viscosity of 1700 to 8000 SSU. The oil preheat for burning should then boost the oil to between 160 F and 210 F to allow the oil to vaporize as it leaves the burner nozzle. Specific temperatures are governed by performance of, and experience with, burners utilized. Using Fig. 2, the

equations employed for heating are:

$$Q = UA\Theta_m = WC(T_2 - T_1) = W_s h,$$

where:

- Q = heat transferred (Btu/hr)
- U = over-all coefficient of heat transfer (Btu/hr per sq ft in deg F)
- A = surface area for heat transfer (sq ft)
- Θ_m = log mean temperature difference between oil and heating fluid in deg F; $(T_2-T_1)/\log_e [(T_3-T_1)/(T_3-T_2)]$
- W = weight rate of oil (lb/hr)
- C = specific heat of oil (Btu/hr lb F)
- ΔT = oil temperature rise in deg F; T_2-T_1
- W_s = steam (or water) rate (lb/hr)
- h = change in enthalpy of steam from vapor to liquid (Btu/lb).

Going further, for steam heat the surface area required can be determined from:

$$A = \frac{WC}{U} \log_e \frac{T_3 - T_1}{T_3 - T_2},$$

where T_3 = steam temperature.

For design purposes, consider C = 0.5 and U = 20 for moderately clean ¾-in. steel tube exchangers, or:

$$A = 0.025\ W \log_e \frac{T_3 - T_1}{T_3 - T_2}.$$

Should the designer want rough values of surface areas using steam at 5 psi for suction heaters (heating oil from 40 F to 110 F), use: A = 0.012 W. For preheaters (heating oil from 110 F to 180 F), use: A = 0.023 W. For electrical heating, the equation is: H = 0.000146 W $(T_2 - T_1)$, where H is kilowatts.

Cold Start Problem

Incidentally, the cold start problem should be evaluated carefully as it represents a considerable potential headache. Many plants provide a small starting tank of light grade commercial oil to use until sufficient steam is available to cut over to Bunker "C". Other plants use electric heat to preheat small quantities of heavy oil until steam is available. Still others start up on gas, particularly the dual firing units.

The suction heater is generally of two types, horizontal or vertical. The preheater is usually horizontal. Selection of the heater is optional and dependent upon location, accessibility, and cost. In either case, manufactured exchangers are normally straight or "U" steel tube, and steel or cast iron shell. Some copperclad tubing is used where the steam or hot water might be corrosive.

The prime considerations in the installation of suction heaters must be maintenance accessibility and performance. Oil is dirty to handle and difficult to contain and the maintenance man should be given every advantage. Should the horizontal heater be used, certain operational maintenance features should be considered. The inside horizontal suction heater, being totally immersed, must be sized to pass readily through the manhole. Weld lugs to the heater shell and underside of manhole cover provide a connecting chain and easily-handled piping disconnects to facilitate removal of heater. Do not attach the heater to tank.

The vertical heater usually is bolted to a tank manhole and is readily removable. This type is best in most cases. Should the vertical heater be too short to reach within 6 to 12 in. of the bottom, install a sheet metal shroud around the heater and extend as required. A "home made" copper or pipe coil can be used to surround the suction line, but this is generally unsatisfactory on heavy oil in large quantities and should be avoided except for small quantity oil flow and inexpensive installations. It can be effective in smaller commercial installations as the coil tends to supply local heating and short circuits hot oil, thus requiring less heating.

Control Temperature

In areas where the subsurface ground temperature drops below 40 F, secondary tank tracers should be installed and the temperature controlled to prevent cold oil breakdown. This should consist of a few rows of bare pipe in the tank bottom with low pressure steam or circulating hot water. Oil lines should be steam traced occasionally with a bare line inside the pipe but more generally with a line strapped to the outside and insulated.

The most critical feature of oil handling is pumping. Oil must be transferred from the storage site to the burners. Do not attempt to size the lines — particularly suction lines — by rule of thumb; consider the lines in detail. More grief can be eliminated through proper design of oil suction lines (and suction heaters) than at any other part of the system.

To accomplish the design, consider the total hydraulic head equation:

$$\frac{\Delta P}{\rho} + \Delta Z + \Delta \frac{V^2}{2g} + H_L = H_{input},$$

In that equation, terms are as follows:

- ΔP = change in pressure (lb/ft²), or
  = gage reading in psi × 144
- ρ = weight of oil (lb/ft³)
- ΔZ = change in elevation (ft)
- $\Delta \frac{V^2}{2g}$ = change in velocity head, $\frac{(ft/sec)^2}{2(ft/sec^2)}$
- H_L = friction loss in system (ft)
- H_i = input head to the system (ft).

In other words, the change in total head (consisting of gage pressure, elevation, velocity and friction loss) from any given point to another in the system must be equal to the head energy imparted. It is best to consider suction and discharge lines separately and combine the results to determine pump sizing. As an example, consider the suction line in Fig. 3.

ΔP is the change in gage pressure between the two terminal points on the line, or: $(14.7 - P_s) \times 144$. ρ is the unit weight of the oil, or 63.6 lb/ft³. ΔZ is merely the change in elevation between the two end points and is determined by the geometry of the installation. $\Delta V^2/2g$, representing velocity head, is usually so small that it can be neglected.

Development of friction loss reverts to the discussion of viscosity. Since the majority of oil pumping installations are laminar flow (Reynolds Number less than 2000), the basic friction equation is:

$$P_L = \frac{0.000273\ \mu\ LQ}{d^4},$$

where:

- P_L = friction pressure drop (psi)
  $= \frac{\rho H_L}{144} = 0.44\ H_L$
- $\mu = \nu$ (specific gravity)
  = 1.02 ν (centistokes)
  = 0.225 (SSU) (approx.)
- L = equivalent length of piping (ft)
- Q = flow (gpm) = 0.00196 W (lb/hr)
- d = pipe diameter (in.).

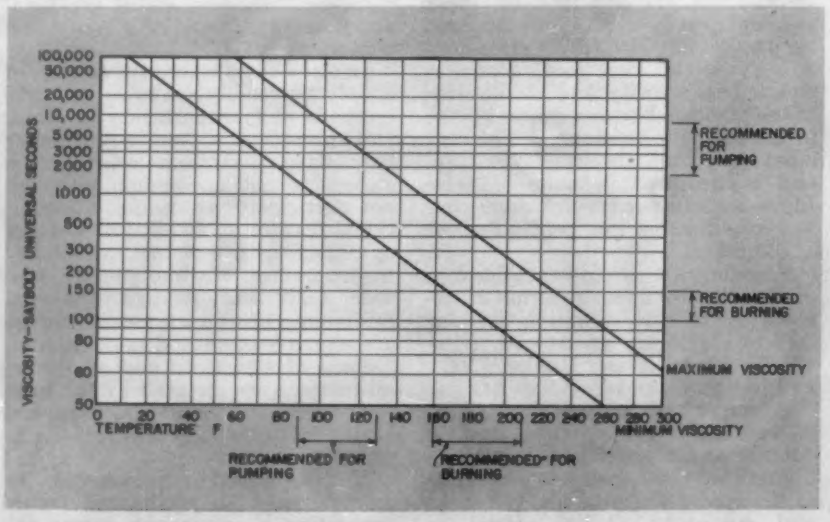


Fig. 5. Graph defines viscosity-temperature relationship of Bunker C fuel oil. Note that recommended viscosity and temperature for pumping and burning differ

Combining the above analysis, the change in head between ends of the line can be written as:

$$\Delta P + 0.44\Delta Z + \Delta P_L = \Delta P_{input},$$

where:

$$\Delta P_L = 0.0000614 \frac{LQ\,(SSU)}{d^4}$$

ΔP_{input} = lift head required to overcome elevation and friction values.

For development of equivalent length, the reader is referred to any of the standard texts, where each fitting is represented as an equivalent length of straight pipe. Some examples of this equivalence are listed in the accompanying table.

One item the designer must remember is that the sum of all equivalent length figures must be for a single pipe size. To correct many sizes to a single equation solution, multiply by the diameter ratios to the fourth power for laminar flow, or:

$$L_a = L_b \left(\frac{D_a}{D_b}\right)^4,$$

where:

L_a = equivalent length at diameter A
L_b = equivalent length at diameter B
D_a = diameter of pipe A
D_b = diameter of pipe B

After the equations have been evaluated for both suction and discharge, they may be combined to determine pumping head required, as:

$$\Delta P_{suction} + \Delta P_{discharge} + \Delta P_{burner} = \Delta P_{pump}$$

The ΔP_{burner} is the burner pressure requirement and actually represents P_L for the burner.

The pump horsepower is:

$$HP = \frac{Q\Delta P_{pump}}{172}$$

where: Q = gpm, and ΔP = psi.

Types of Pumps

Four types of pumps are used in handling oil. They are reciprocating, gear, rotary or screw, and centrifugal. The reciprocating pump is unquestionably the most reliable and has the lowest maintenance. It does have drawbacks, principally low efficiency and moving the oil in slugs, making it difficult to control burner operation without a large surge chamber to damp the fluctuations. On the suction side the pump will generally pull 27 inches of mercury (13.3 psi) quite readily without priming. It produces a flow that is variable as required by oil pressure and steam quantity supplied, and is capable of high pressure.

The gear pump is quite reliable with moderate maintenance. Its efficiency is high and oil pressure fluctuations are small. On the suction side, the pump will generally pull 25 inches of mercury (12.3 psi) when primed. It produces essentially a constant flow at variable pressure.

The rotary or screw pump operates similarly to the gear pump although it is not normally used for higher pressures and suctions. On the suction side the pump will generally pull 17 inches (8.4 psi) of mercury when primed. It produces essentially a constant flow at variable pressure.

The centrifugal pump is seldom used for heavy oil handling as it is more suited for higher capacity and lower head operation. On the suction side it is seldom used to pull more than 12 inches of mercury (5.9 psi), and its discharge is along a definite decreasing head-increasing capacity curve.

When considering selection of pumps and drives, consider maintenance safeguards such as duplicate pumps, each capable of carrying full load, with one steam driven for operation in case of loss of power and one electric motor driven for operation in case of loss of steam. When pumping heavy oil, moderately oversize the drivers for cold starts, etc.

Table below shows comparison of liquid flow through straight pipe, typical fittings

Fitting	Equivalent Straight Length of Pipe in Diameters
90 deg screwed elbow	30
90 deg flanged or welded elbow	20
45 deg screwed elbow	15
45 deg flanged or welded elbow	10
Run through screwed tee	20
Side outlet tee	60
Gate valve (open)	8
Globe valve (open)	330
Check valve	80
Oil flow meter	400

Piping Design

In designing piping for pumping, some additional considerations are advantageous. Place duplex strainers on all pump suctions to avoid damage to pumps. Make provisions, such as check valves, to keep the suction and discharge lines full so no priming is necessary after a prolonged shutdown. Place the steam line and the suction line within the same insulation for line tracing. In addition, take every precaution to design the suction line large enough and with minimum quantity of fittings and joints to reduce friction and possible air leaks. The reciprocating, gear, and screw pumps require safety relief bypass lines for pressure protection. Do not use "rule of thumb" — *design* the line.

Three general types of burners are used for firing: steam, or air atomizing, mechanical atomizing, and rotary cup. Without attempting a detailed comparison, the use of each burner is quite often economically defined as follows. When the boiler or furnace has independent draft fans, and generally always when the load exceeds 400 boiler hp, the atomizing burner is best. Most large installations use steam atomizing burners. Specific burner specifications are generally dictated by the boiler manufacturer. To fire with heavy oil, an oil pressure of 100 to 200 psi, oil temperature of 180 to 200 F, and steam pressure of 75 to

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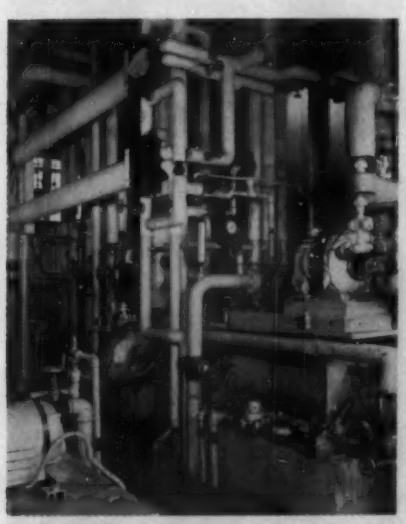

Fig. 6. Fuel oil pump and heater set. Steam-turbine-drive rotary pump, right

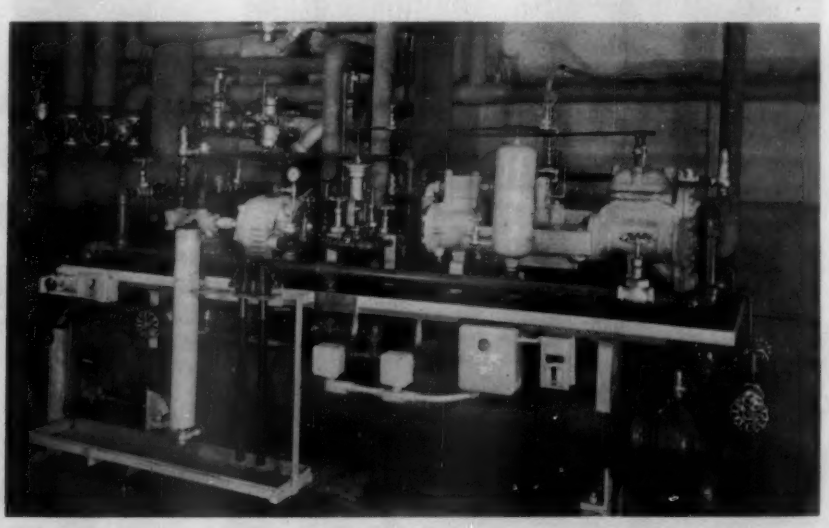

Fig. 7. Another pump and heater set for heavy fuel oil; here, an electrically driven pump (left center) is paralleled with a steam reciprocating pump (right)

Chicago's first skyscraper in 20 years is built over railroad tracks. It will have world's fastest elevators, highest escalators, coal-fired boilers, year-round air conditioning throughout. Here are details

Fig. 1. Construction progress shown by photograph taken in mid-February 1955

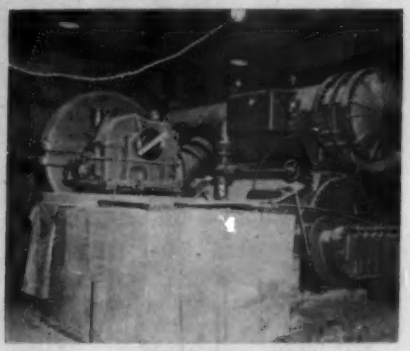

Fig. 2. Heart of air-conditioning system. One of three 900 ton centrifugal compressors before motor was installed

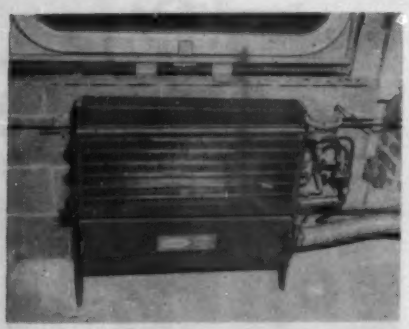

Fig. 3. Construction view of Carrier Weather-Master unit in perimeter office

Fig. 4. Shows installation of one of three water-tube boilers which will provide steam for heating the building

Complete Air-Conditioning a Feature of Prudential's New Chicago Building

PRUDENTIAL INSURANCE Company's new Mid-American Home office, now building on Chicago's lake front, will be the city's first skyscraper since the Field building was completed 20 years ago.

Traditional "topping out" ceremony for the new building took place on November 16, 1954, 13 months after first steel was erected. Ground was broken in August 1952, and completion is scheduled for late 1955.

For heating and air-conditioning this great building, a complete steam and refrigeration plant is being installed. It will house several steam boilers, with their fuel and ash-handling equipment, large air compressors, refrigerating compressors, circulating water pumps, and all the accessory equipment one normally finds in a large industrial power plant.

All electric power for the building services will be purchased from the local utility.

The building is located over the Illinois Central Railroad tracks between Michigan Avenue and Lake Michigan. Though this made a difficult design and construction job, it has advantages as far as fuel handling is concerned, since rail cars of coal or oil can be brought right into the building basement before unloading.

Heating

Three Erie City bent tube boilers, one 306 hp, and two 558 hp, operating at 125 psi, will provide steam for heating the building. The boilers will be coal fired with Detroit spreader-stokers, or oil fired with Peabody mechanical steam atomizing oil burners, for firing on #6 fuel oil. Figure 4 shows one of the boilers under construction.

In addition to these boilers, the building is equipped with a 250 hp Cleaver-Brooks packaged boiler, fired with gas, which will generate process steam for kitchens and water heaters.

From the boiler plant, steam is piped to converters located at various floor levels. In these converters, one of which is shown in Fig. 5, heat is transferred from the steam to water to serve the Weather-Master units.

The stairwells, toilets, and rest rooms are heated by direct steam radiation, but the offices are heated with hot water. For the perimeter area, Carrier Weather-Master units, with individual control, will be used at each window.

Coal is discharged from the railcars through a track hopper, and carried by drag conveyor, and bucket elevator to the main storage bunker. This concrete bunker has a total capacity of 1000 tons and is divided into four compartments. From each of three of these compartments, coal flows by gravity to a weighing hopper and from there to a boiler. From the fourth compartment, coal is moved by Redler conveyor to a separate 1000 ton reserve storage bunker.

Thermocouples are distributed at different points in the bunkers to indicate danger of spontaneous combustion.

Three 900-ton electric motor driven Carrier centrifugal compressors, using Freon 11, form the heart of the air-conditioning system. Figure 2 shows one of these large compressors before its motor was installed.

From the refrigeration machines, chilled water is pumped to the dehumidifiers. After cooling the ventilating air for the upper half of the building, the chilled water at 55F is pumped direct to the Weather-Master units in the perimeter offices. One of these units during construction is shown in Fig. 3. For the lower half of the building, by means of water to water heat exchangers, the chilled water is used to cool a secondary water system at 55F, feeding directly to the Weather-Master units. One of these heat exchangers is shown in Fig. 5. The ventilating air will be heated by low pressure steam coils.

One feature of this air-conditioning system is the latest Minneapolis-Honeywell Electronic control system by which the engineer can remain at his control panel and check and regulate temperatures on every floor, and also control air conditioning fans located on each floor. Valve and damper operation will be a pneumatic system.

The large quantity of condenser water required for the air-conditioning system comes from the Chicago River through a 30 in. pipeline via a traveling intake screen located in the basement, and is discharged after use into a storm sewer and so into the Chicago River.

Fig. 5. Construction photograph showing (A.) water-to-water heat exchanger, and (B.) steam to water heat converter

Electrical System

Electric power enters the building at 12 kv, by underground cables, and is transformed down to distribution voltage in four transformer vaults. In the basement vault it is changed to 480v for the compressors and power equipment, and in the vaults on the 1st, 19th and 40th mezzanine floors, it is changed to 208/120 volt 3-phase 4 wire for general distribution. There are five 3-phase transformers in each vault, and each transformer is fed by a feeder which comes from a different city-substation, so the chances of a total failure in the whole building are remote.

Distribution is by bus-duct risers. The cellular floor is used for wiring to telephone and electric outlets in all offices.

Transformers are 750 kva each in the three main vaults, while the basement transformers are 1000 kva each.

The building will have a total of 30 Otis elevators, operating at 800, 1000, and 1400 ft per min. There will be a total of 12 escalators, made by Westinghouse, serving the first four floors, and in addition there will be four from the 39th floor to the observation deck at the very top of the building.

All windows are double glazed and are arranged to pivot about their vertical axes so that both sides can be cleaned from the inside of the building. Round the periphery of each window runs a rubber tube which can be inflated to seal the window when closed, and deflated when the window needs to be opened. In addition to this convenient cleaning arrangement, the double glazing reduces heat losses through the windows.

Naess and Murphy are the architects and engineers for the building, and the general contractors are George A. Fuller Company.

Glass Bubbles Make Tough, Versatile, Insulating Wall

This unique material permits one-pass construction of a self-supporting, self-insulating, corrosion-resistant, and impact-resistant wall that needs no further finishing and can be washed indefinitely

BUILDING A WALL of bubbles may not sound like good sense or good engineering, but it is being done economically and successfully. The bubbles are made of glass and (when taken by the trillions) comprise an extremely light-weight building block which is strong, rodent-proof, vermin-proof, unaffected by fungus, is rot-proof, fireproof, and is unaffected by most chemicals. The block's rigidity, strength and impact resistance make it suitable for the building of unsupported walls. Another characteristic — it is moisture-proof — makes it desirable for walls in humid and/or extremely cold areas.

Called "Duraface", the new material is based on the familiar "Foamglas" building block. The difference lies in a dense, white ceramic face which has been added to improve impact resistance and durability. This layer is fused to the black insulating block in the initial manufacturing process, so there is no likelihood of its chipping off or flaking. No additional painting or finishing of the surface is required, though various types of paint can be applied.

Standard blocks are 18- by 12-in., and are available in 3-in. or 4-in. thicknesses. Hot asphalt or a cold adhesive may be used between blocks, and they may be cut to size on the job with a carborundum saw blade. When a double course wall is to be laid, the manufacturers suggest Duraface blocks for the exposed surfaces and Duraglas for the concealed course. Joints are easily sealed against moisture seep since the block edges are bevelled 0.25 in.

An insulation which can be scrubbed with a stiff brush should be welcomed in cold storage plants, dairies, chemical storage areas, and food processors' plants.

Fig. 1. Both layers (facing and base) are visible in this view of new block

IF YOU want a free sample block or more information on this versatile material mailed to you, write GLASS BLOCK on the prepaid postcard elsewhere in this issue.

Fig. 2. The dense, moisture-proof face can be scrubbed with strong cleaners

Fig. 3. Ceramic surface can take impact, does not support vermin or fungi, and is integral with the effective Foamglas insulation. This surface is not painted

This New Armored Cable System Costs Less, Looks Better

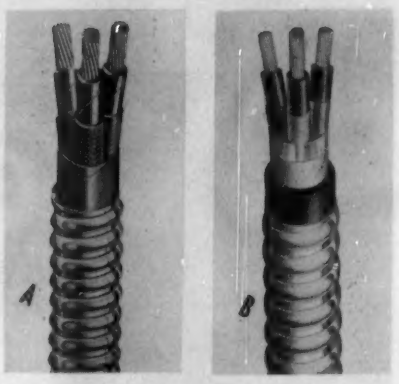

Fig. 1. VCI cable used with this system. A. For indoor, B. Outdoor, installations

Up to now, untidy appearance of armored cable has limited its use and obscured its many advantages. Now a neat, low-cost support system has been developed. It is described here. In a future article we'll show savings in cost, space, and other advantages

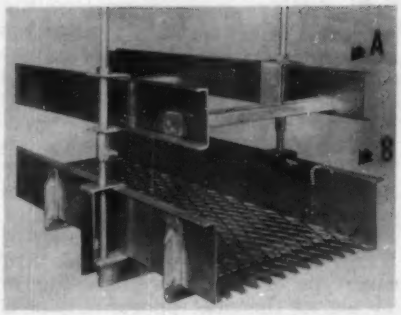

Fig. 2. A. Cable rack, and B., Cable basket, for interlocked armored cable

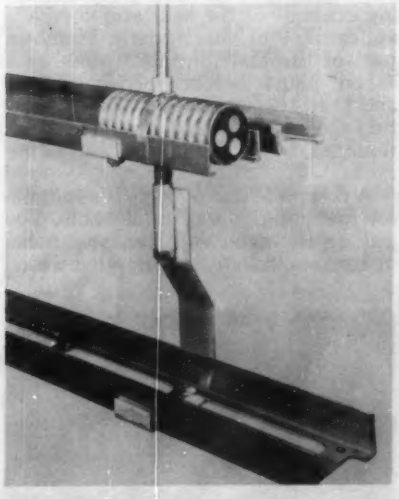

Fig. 3. Type of cable troughs for a single large or several small cables

ALTHOUGH INTERLOCKED armored cables have been used for many years for plant power distribution, their use has been limited and their many advantages obscured by poor appearance. Now a factory-built, completely coordinated support system is available which removes this objection and enables the real advantages of armored cable to be seen in direct comparison with other forms of distribution.

Figures 1A and 1B show the type of cable we are talking about. The cable itself is varnish-cambric insulated, and the interlocked armoring allows the cable to be handled very easily. One of the disadvantages of the older type of steel wire, or tape armoring, was that it was stiff and extremely difficult to handle during installation.

For indoor installations, in dry locations, a weatherproof braid under the armor as shown in Fig. 1A is used; for outdoor or damp locations, an impervious jacket as shown in Fig. 1B is used. Butyl-insulated interlocked armored cables are also being made. Fireproofing cables after installation is very expensive, and there is a trend towards more cables with polyvinyl chloride jackets and interlocked armor, giving built-in fireproofing.

Interlocked armor cables are also used for control circuits.

There are three types of support of this cable: cable racks, cable troughs, and cable baskets. Cable racks, illustrated in Fig. 2A, are rather like aluminum alloy ladders with rungs on 18-in. centers. The gaps between the rungs allow cables to drop through as shown in Fig. 8. The racks are made in standard 24-ft lengths in several widths from 9 to 24 in.

Cable troughs shown in Fig. 3 are made from aluminum alloy extrusions for use with single large cables or a few small ones. The troughs are perforated to give the cables ventilation, and are made in lengths of 16 ft and widths of 3 and 4 in.

Cable baskets (Fig. 2B) are made with aluminum alloy channel stringers and an open diamond-mesh aluminum alloy bottom. These baskets use the same supports as the cable racks and come in lengths of 16 ft. Their extreme lightness is well illustrated in Fig. 6.

All three types of support are made of 61S-T6 aluminum to provide high strength, light weight, non-magnetic units which are easy to install and will also resist corrosion.

The system is designed to reduce weight to a minimum. In average plants with 20-ft bays, only one support in the center (10 ft) is required. In addition, a cable rack with 4-in. side stringers is available for 20-ft unsupported spans.

Fittings

For this type of cable, fittings are provided which make a simple and inexpensive termination without a pothead. For use with apparatus already equipped with potheads, a special flanged terminator is provided. Another type of fitting is available for terminations on outdoor metal-clad equipment or for roof and wall entrances. Figure 5 shows fittings for splicing or terminating VCI cables. Figure 4 shows the termination of a VCI cable in 4160 v switchgear, and Fig. 7 shows a flange-type fitting used to terminate VCI interlocked armored cable in a pothead. Figure 8 shows the neat appearance of this cable dropping from the ladder-type rack down to cubicle switchgear.

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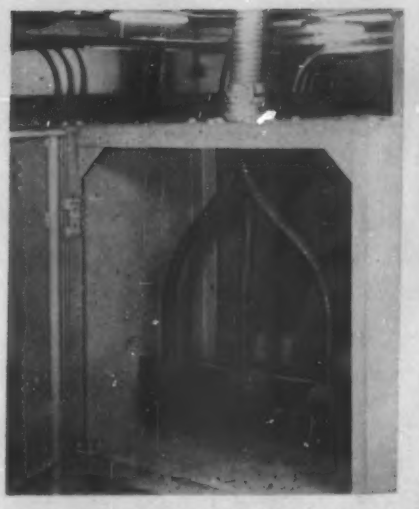

Fig. 4. Method of terminating a VCI armored cable in 4160 volt switchgear

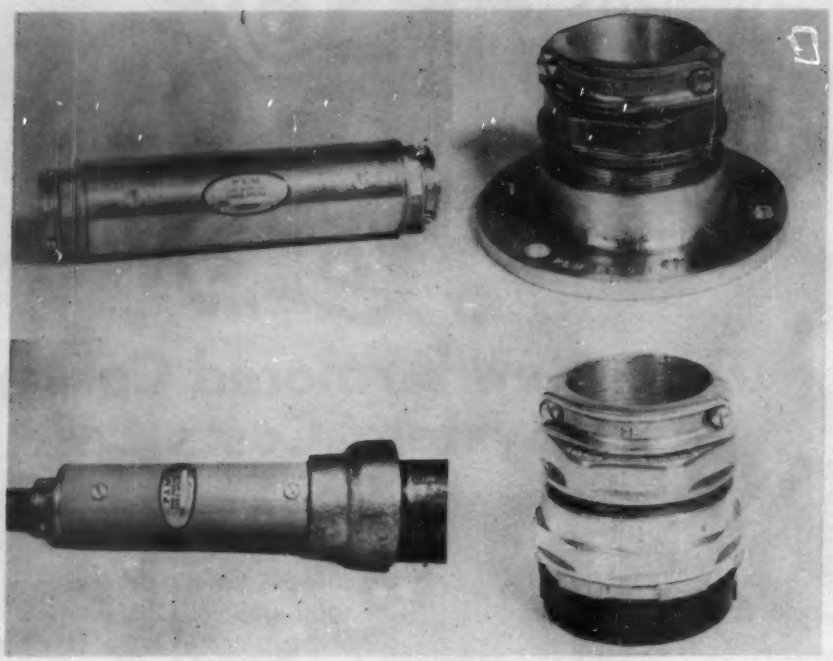

Fig. 5. Right. Fittings for terminating or splicing VCI cable to enable it to be used with other distribution systems

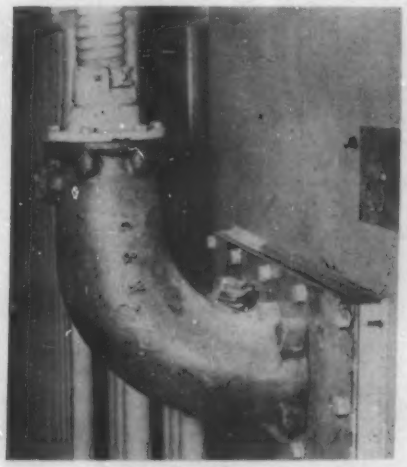

Fig. 6. Above. Illustrating lightness of the aluminum alloy cable baskets

Fig. 7. Left. Flange type fitting used to terminate VCI cable in a pothead

Fig. 8. Below. Neat appearance of cables dropping from rack to switchgear

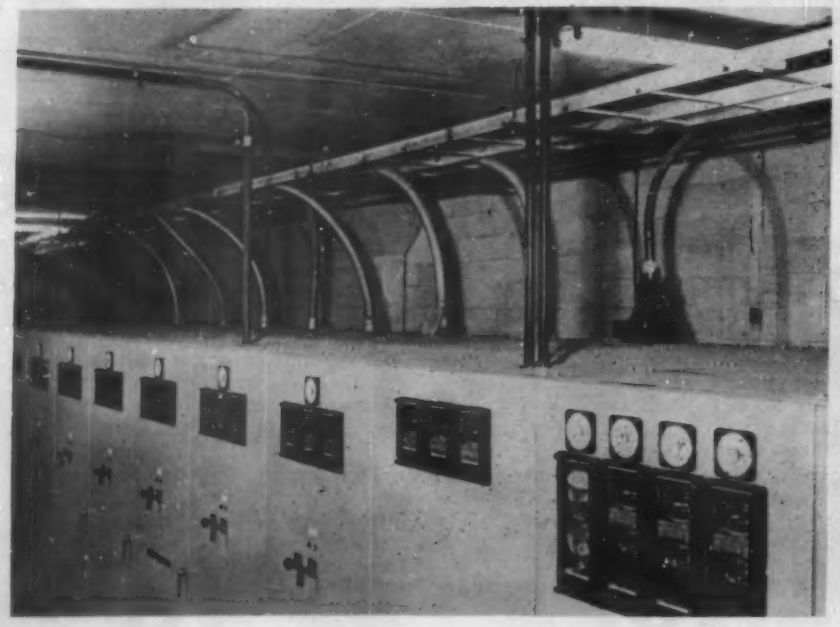

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Figure 11 shows splices being made between two VCI cables and between a VCI and a lead cable. Special ends are provided for splicing between lead and VCI cable. Ends are also available for splicing non-metallic cables to armored cables or any possible combination of leaded, non-metallic and armored cable, as well as conduit in straight splices and branches; and there is no difficulty in fitting interlocked armored cable into any type of existing system. Figure 10 shows the neat appearance of a splice when completed, and Fig. 12 shows how VCI cables on racks can be added to an existing system without difficulty. Figure 15 gives a striking example of the neat and compact appearance of this system. It shows part of the distribution system in a rayon plant before modernization, and then the same plant after the untidy mess of overhead wires had been replaced by VCI armored cables on racks.

A complete line of tools is available for installing this type of cable. For pulling the cable into troughs, racks or baskets, rollers are provided which

Fig. 9. VCI cable on racks for distribution across roof of aircraft plant

Fig. 10. Above. Shows neat appearance of VCI splice when laid on cable rack

Fig. 11. Left. Construction of splices between two VCI cables and also between VCI and lead covered cables

Fig. 12. Below. VCI cables on racks can easily be added to an existing system

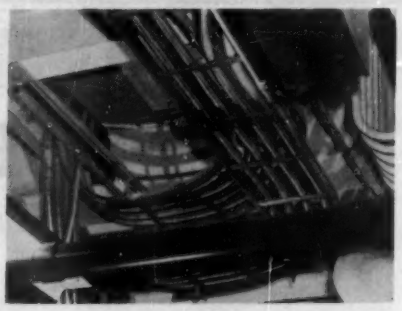
fit onto the sides of the support during installation. In general, a 20-ft spacing is used for light cable. A 12-ft spacing for the heaviest cable will avoid any damage to cable or cable-rack rungs. For pulling cable around bends, single and triple pulleys are provided. Figure 13 shows a large cable being pulled around a 90-degree bend using a triple pulley.

With the help of this equipment, lengths of cable up to 1000 ft and with as many as a dozen or more bends may be pulled in one continuous operation at a speed of 20 to 25 ft per min.

The above information was included in a paper presented at the June '54 AIEE meeting at Los Angeles by L. F. Cudlin, cable specialist, General Electric Co., and F. V. Calvert, vice-president, Husky Products, Inc.

In another article in the near future, figures will be given for comparing costs of this new system with other types of distribution in common use. The article will also discuss other advantages of the system which have become more apparent now that the obstacle of poor appearance has been removed.

Fig. 13. Pulling armored cable round a 90 degree bend using triple pulley



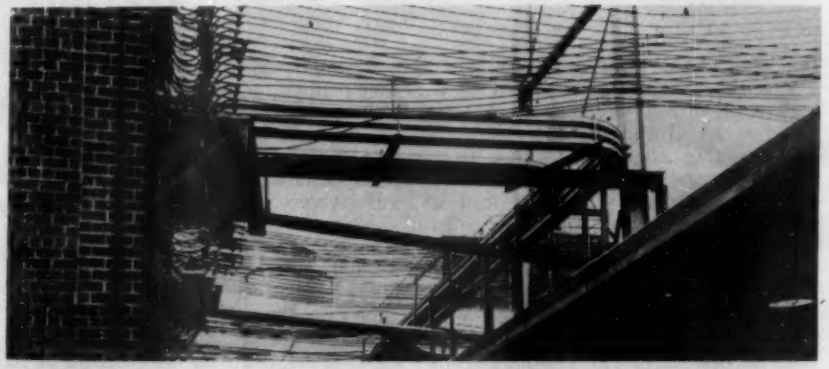


Fig. 14. Interlocked armored cable on racks can be used for generator leads

Fig. 15. Above. View before modernization of part of rayon plant. Below. Same part after modernization with mess of cables replaced by armored cable on racks

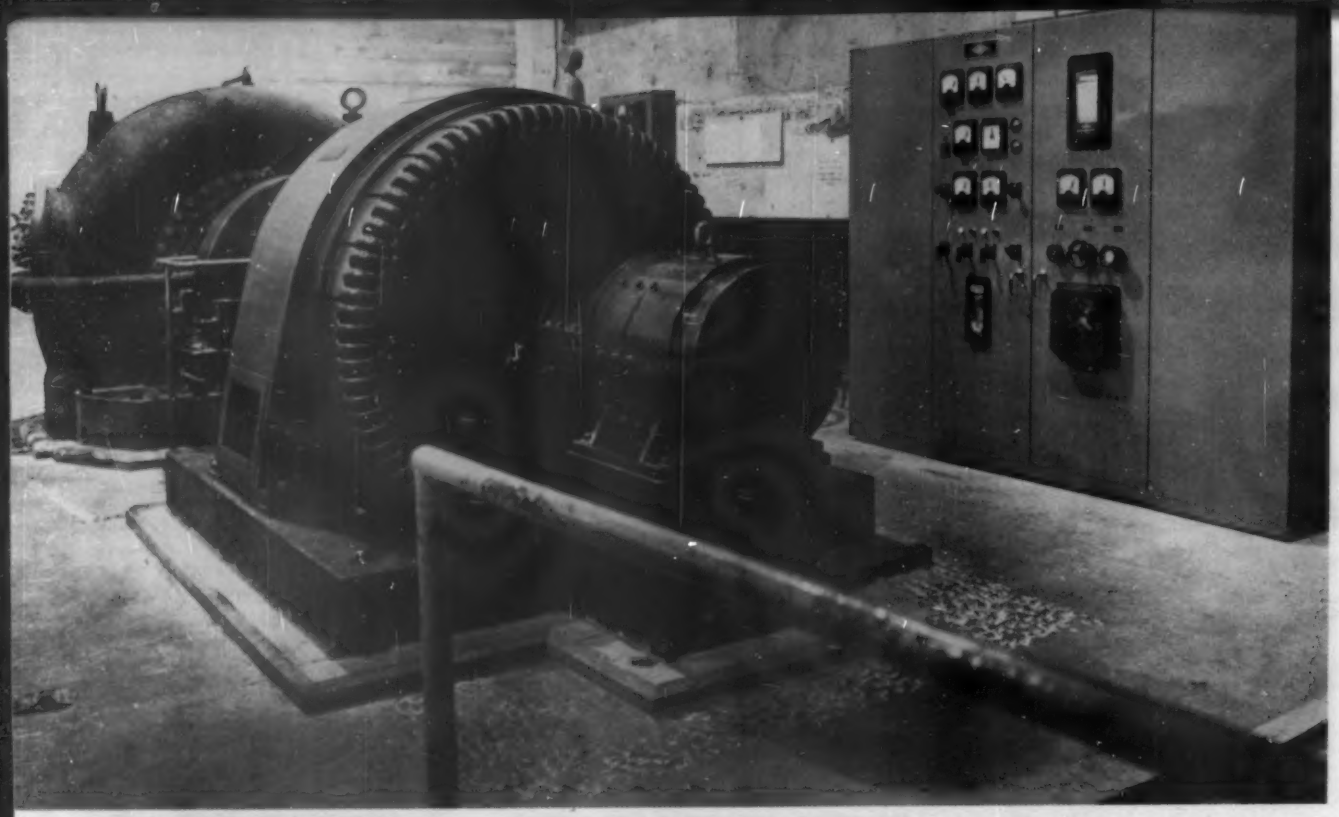


Fig. 1. New hydraulic turbine recovers more power from water supply than is needed to pump it over intervening hill

Water by Bootstrap for Port Alice

Alaska Pine and Cellulose Ltd. has an excellent natural storage basin for process water, but a hill is between the mill and this reservoir. Their solution: Pump through a pipeline over the hill, then recover the power with a hydraulic turbine at discharge

NOT EVERY plant is blessed with an abundant water supply at a higher elevation than the plant — or even an abundant water supply regardless of elevation. Those that are so blessed, such as Alaska Pine and Cellulose Ltd., usually find a fly in the ointment somewhere. In their case, a 250-ft hill intervened; and the hill was broad enough to preclude economical tunneling for a straight gravity-flow system.

Until recently, a 24-in. wood-stave pipe carried 12,600 gpm from pumps on the shore of their reservoir (Victoria Lake) about two miles across the hill to a 1200-hp hydraulic turbine. This turbine (and generator) was located 3500 ft from the mill and 150 ft above high tide, and it discharged into a 50,000-gal screen tank. The electrical generation was short of the requirements of the lake pumps and a tie was necessary to feed the extra power from the mill power plant. If any electrical disturbance threw the breakers in this tie, the pumps would close down, the mill water and b.f. makeup supply would stop, and the entire system remained off the line for several hours while the fault was corrected, valves were manipulated manually, the line was primed, and the hydraulic turbine-generator was synchronized with the mill power plant. The old system also required an attendant at the pump house 24 hours a day since the valves were manually operated.

Recent expansion of the mill jumped water requirements from 12,600 gpm to 28,000 gpm — which is far beyond the capability of the old pipe line. Consultants W. O. Stevens & Co., who had done previous work on this installation, were called in to investigate the new requirements. While investigating means of meeting the new water requirements, they were to look for ways to improve the reliability of the entire water supply.

As a result of Stevens' investigation and engineering, Alaska P. and C. now has a new 38-in. steel pipeline, new pumping and remote control facilities, and a new hydraulic turbine-generator set which produces more power than is required by the pumps. The new water screens and turbine (a Vickers 3500-hp unit driving an Elliott generator) are located at the mill where power house and mill personnel can tend the machines.

The most significant change in the pipeline was the change from use of an open surge tank at the crest to use of a siphon. Hydraulic losses are kept to an economic minimum, and air collecting at the crest is promptly pumped off by a vacuum pump so that the system is self-sustaining even if a fault causes an outage on the main power house bus. Such a fault, tripping the tie circuit breaker through a low-frequency relay, cuts the hydraulic system free from the steam system. The excess power generated is absorbed by the pumps, which run at a higher speed during isolation.

Two wet-pit type pumps in a new pump house pump 14,000 gpm. They use a common screen and inlet pipe, but are separated by sluice gates on their inlets and roto-valves on their outlets. They then enter the common pipeline. As vacuum increases at the pipe crest, the pump flow increases due to decreased discharge head, and the turbine flow decreases due to decreased head, to maintain desired siphon conditions. Water hammer is prevented by a synchronous by-pass

See Fig. 2 and Table on opposite page — article continued on page 123

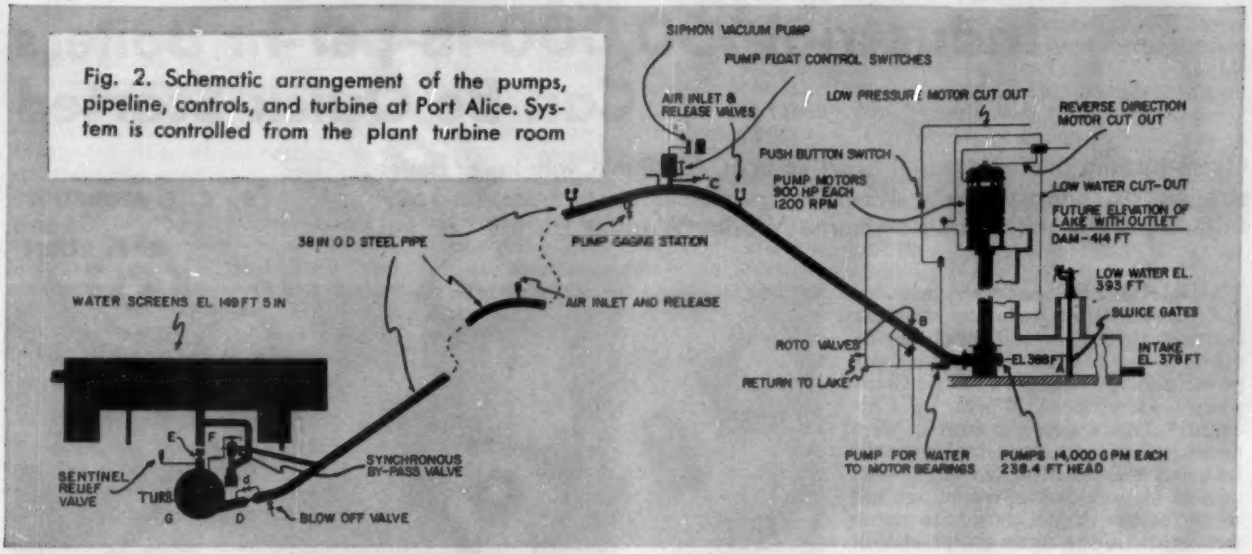

SIPHON VACUUM PUMP
PUMP FLOAT CONTROL SWITCHES
AIR INLET & RELEASE VALVES
LOW PRESSURE MOTOR CUT OUT
REVERSE DIRECTION MOTOR CUT OUT
PUSH BUTTON SWITCH
PUMP MOTORS 900 HP EACH 1200 RPM
LOW WATER CUT-OUT
FUTURE ELEVATION OF LAKE WITH OUTLET DAM - 414 FT
38 IN O D STEEL PIPE
PUMP CASING STATION
LOW WATER EL. 393 FT
WATER SCREENS EL 149 FT 5 IN
AIR INLET AND RELEASE
SLUICE GATES
ROTO VALVES
INTAKE EL. 378 FT
EL 368 FT
RETURN TO LAKE
SYNCHRONOUS BY-PASS VALVE
SENTINEL RELIEF VALVE
BLOW OFF VALVE
PUMP FOR WATER TO MOTOR BEARINGS
PUMPS 14,000 G P M EACH 238.4 FT HEAD

Fig. 2. Schematic arrangement of the pumps, pipeline, controls, and turbine at Port Alice. System is controlled from the plant turbine room

Table of operating procedures for the Port Alice installation. Note that valves are keyed by letter to diagram in Fig. 2

Valves → / Operation ↓	Sluice Gates at Pumps A	Roto-Valves B	Valve at Line Crest C	Turbine Inlet Shut-Off D	Turbine Inlet Shut-Off Bypass d	Turbine Outlet Shut-Off E	Synchronous Bypass F	Turbine Wicket Gates G
Prior to starting pumps	Open	Shut	Open	Shut	Shut	Open	Open	Shut
Start first pump	Open	One open	Open	Shut	Shut	Open	Open	Shut
Start second pump	Open	Two open	Open	Shut	Shut	Open	Open	Open
When line is filled to its crest	Open	Open	Open	Shut	Shut	Open	Close Manually	Open
When penstock is full	Open	Open	Open	Shut	Shut	Open	Open manually to 2-pump pos.*	Close
Synchronize turbine	Open Open Open Open	Open Open Open Open	Shut Shut Shut Shut	Shut Open Open Open	Open Open Shut Shut	Open Open Open Open	Open Open Open Close by synchronizing motor	Open by synchronizing motor
Adjust siphon	Open	Open	Shut	Open	Shut	Open	Shut	Adjust manually by gate limit control
Normal operation	Open	Open	Shut	Open	Shut	Open	Shut	Auto. telemeter control for siphon pressure
Failure of one pump (alarm and red light)	Open	One closes	Shut	Open	Shut	Open	Close manually to 1-pump pos.	Same as for normal operation
Failure of two pumps (alarm and red light indicators)	Open	Two Close	Shut	Open Shut	Shut	Open	Open as siphon control closes wicket gates. Close manually	Close by siphon control. Open as synchronous by pass closes
Failure of hydro-generator (current relay disconnects woodroom from main bus)	Open	Open	Shut	Open Shut Shut	Open Shut	Open Open Open	Open by gov. Open	Close by gov. Shut
Failure of steam turbines (frequency relay disconnects lake-line cubicle from main bus. Surplus power operates pumps faster)	Open	Open	Shut	Open	Shut	Open	Shut	Auto. telemeter control for siphon pressure

* Start to open prior to the pressure build-up at pipeline crest.

Industrial 150,000-lb-per-hr Boilers Can Be Quick-Started

Quick-starting methods permit start-up in 60 to 90 min, with lower boiler stresses, as contrasted with 4½ hr for conventional start-ups, on 150,000-lb-per-hr boilers at Hawthorne Works, Western Electric Co., Inc.

By C. E. MORROW* and R. F. BORN†

DURING THE last two years an investigation was made of fast starting 900-psi, 150,000-lb-per-hr pulverized-coal-fired boilers in the power plant of Western Electric Company's Hawthorne Works in Chicago.** Operating procedures were developed so that these boilers could be safely started after overnight outages in 60 min. For extended outages when boilers have cooled to room temperature, the units are placed on the line after 90 min of firing. Boiler manufacturers usually recommend that firing be limited to raising the boiler water temperature no faster than 100 F per hr. Following this procedure results in 4½ hours of firing in 900-psi equipment.

Seasonal variation in steam demands makes operation of all boilers unnecessary during the summer months and one of the three units is off the line every week-end the year around. In order to make steam plant operation more reliable and flexible, a substantial reduction in boiler starting time, relative to standard recommendations, is desirable.

Initial Problems

During the planning period, when it was necessary to consider all the points in the boiler that might cause trouble during accelerated starts, a consultation was held with engineers of the Riley Stoker Corp. (the boilers under consideration were designed and erected by this firm in 1951 and 52). Results of this meeting pointed to the following factors requiring special consideration:

1. Non-drainable pendant superheater consisting of high- and low-temperature sections is made up of respectively 1 per cent chrome 0.5 per cent moly seamless tubing and carbon steel seamless tubing. Both of these sections should be limited to a maximum temperature to prevent oxidation of the metal. These were decided upon as 1000 F and 850 F. Allowable working stress of the material could not be exceeded at any time during the starting operation.

2. Unusual conditions of boiler circulation might cause substantial differential temperatures to exist between lower water wall headers and side wall tubes adjacent to them.

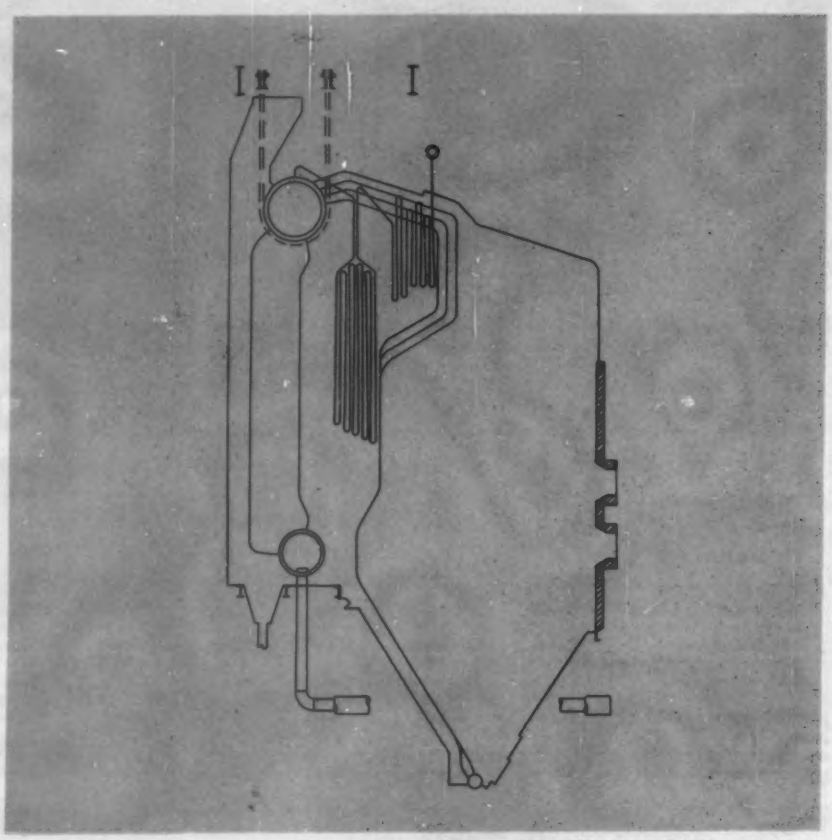


Fig. 1. General cross-section through one of the 150,000-lb-per-hr steam generating units fired by pulverized coal. With new methods this unit can be started up in 1 to 1½ hr instead of the 4 hr required by conventional methods

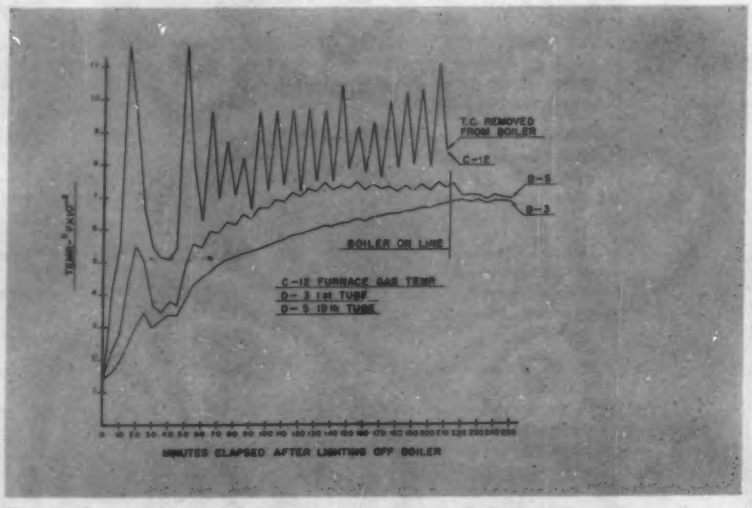


Fig. 2. Curves of superheater temperatures, during start-up by conventional procedure, on a 150,000-lb-per-hr boiler

** Plant described in article Modernization of Hawthorne Power Plant Yields Big Savings, POWER ENGINEERING, May, 1953; also Demineralization Cuts Power Costs at Hawthorne Plant, POWER ENGINEERING, July, 1954.

* Factory Planning Engineer.
† Mechanical Engineer, Hawthorne Works, Western Electric Co., Inc.

This might occur if circulation were to begin suddenly, and the relatively thick headers could not come up to temperature as rapidly as the tubes. Similar conditions might cause substantial differential temperatures within the steam drum, causing it to assume a distorted shape, with resulting over-stress.

In general, the problems seemed to be largely associated with assuring adequate circulation in the boiler and holding superheater metal temperatures down to those necessary during the period while trapped condensate was either being blown from, or evaporated from, pendant loops.

General Procedure Adopted

In accordance with these criteria, instrumentation was provided to measure temperatures at approximately 60 points in the boiler and means were provided to determine distortion of boiler structure.

A system of firing was developed so that large amounts of fuel input could be made, but temperature of the gas would be reduced before reaching the high-temperature superheater. This was accomplished by opening the upper burner air registers and firing only the lower two burners. If the wind box pressure is held sufficiently high, the unit can be fired at approximately 25 per cent of maximum rating with gas temperatures of less than 1100 F at the screen. Using this procedure, it was possible to place boilers on the line after 60 min of firing, if the units had been off the line as long as 50 hours.

Where outages were extended to permit cooling to room temperature, the starting interval was reduced to 90 min.

Unit and Testing Facilities

General arrangement of one of the boilers is shown in Fig. 1. Each is fitted with 4 burners, 2 on each level. The low-temperature section is constructed of SA 192 seamless carbon steel tubing and the high-temperature section of SA 213 Grade T11 seamless chrome-moly steel. All pressure parts are supported from the steam drum level and expansion takes place downward. Arrangements were made to measure expansion of the unit at each end of the lower sidewall headers. In accordance with the conclusions reached concerning the parts of the boiler most likely to overstress, thermocouples were installed on drums, headers, high- and low-temperature superheater elements and two side-wall tubes. Probes for measuring gas temperature before entering the screen and leaving the low temperature superheater were provided.

All thermocouples installed were iron-constantan; 14-gage couples were used throughout except for measuring gas temperatures where 8 gage was employed. Lead wire was asbestos insulated. Thermocouples were attached to tubes, headers and drums by tack welding nuts, drilled in the flat to tube, header or drum surface.

The thermocouples were inserted through these holes and held in place with a bolt. Nuts, bolts, thermocouples and lead wire were situated inside of screwed steel pipe and fittings for protection at points within the furnace.

Gas probes were provided by installing beaded thermocouples in steel pipe closed on one end by forging. A thermocouple scanning device was constructed to operate in conjunction with a standard 12-record potentiometer. It was capable of recording each of the 60 points at approximately 1-min intervals, and this was found entirely satisfactory. Riley Stoker provided a high velocity shielded thermocouple for measuring gas temperatures. It is equipped with a 24-gage noble metal couple and an air-operated aspirator for inducing gas flow over the couple.

Considerable data were collected to determine the accuracy and reproducibility of gas temperature measurements at the screen for a simple probe using an 8-gage iron-constantan couple protected by iron pipe, using the high-velocity gas probe as a standard. The data shows the simple couple to respond with a lag of about 2 min and in steady operation to read about 35 to 80 F high. This is presumably caused by the radiation gain.

These errors were not of any consequence when readings of 1000 F to 1100 F were concerned in this investigation.

Testing Procedures

To provide suitable bench marks, several runs on standard procedures were made using test instruments. Figure 2 shows superheater metal temperatures during a typical test. The curves show the effect on metal temperatures when condensate is either evaporated or blown from trapped loops as the temperature abruptly falls. The temperature of the combustion gases entering the screen is also shown. The intermittent firing necessary when starting with pulverized coal under the conventional procedure causes the cyclic pattern of gas temperature entering the screen. Although the metal temperatures only show a slight effect from this variation, the actual variations are undoubtedly much greater, the mass of the thermocouple being relatively large. In this run the rate of temperature rise in the unit was about 125 F per hr. It was apparent during some of these runs that conventional starting methods would result in occasional over-stress in the low-temperature superheater.

Results Obtained

In the early attempts to increase the rate of temperature rise, an unsuccessful run was obtained each time. It was found that frequent blow-down of the superheater drain

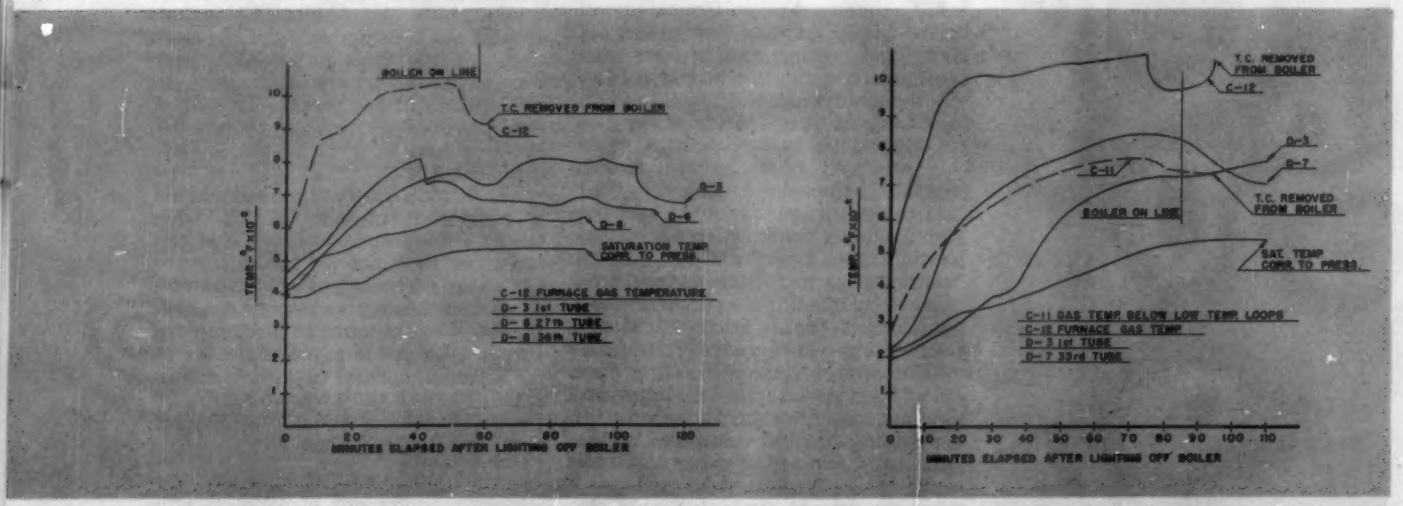


Fig. 3. Curves of superheater temperatures during fast start, after overnight outage, on boiler shown in section in Fig. 1

Fig. 4. Curves of superheater temperatures taken during fast start after extended outage, on the boiler shown in Fig. 1

and water-wall drains was completely ineffective. However, when the following operating procedure was adopted, the unit could be safely started in relatively short periods. It was evident that to materially reduce the starting interval, heat must be supplied to the boiler unit at a greater rate, and at the same time the previous runs had demonstrated that to fire the burners at any greater rate would further overheat the superheater tubes.

In order to accomplish the addition of more heat, but at a lower temperature, it was decided to open the registers and dampers in the upper burners, fire the lower burners, and hold the wind box pressure from ½ in. W.G. to 1 in. W.G. In this way sufficient air was added to the furnace to reduce the gas temperature, but in turn the gas flow rate over the superheater and boiler elements was increased. The firing rate could be increased to an amount equal to 25 per cent of maximum rating without the gas temperature at the screen exceeding 1100 F.

Metal Temperatures

Superheater metal temperatures during a typical fast boiler start from an overnight shut-down are shown in Fig. 3. During this run the rate of temperature rise was about 140 F per hr. Low-temperature superheater metal reached a maximum of about 810 F on three occasions. You will note that side-wall tube temperatures remain relatively low during the starting period and subsequent to going on the line.

Figure 4 provides similar data for a start from extended shut-down. During this run, low-temperature superheater metal reached about 850 F just before going on the line. The rate of temperature rise based on saturation temperature was about 225 F per hr.

It was found that some distortion occurred in all the runs, but in no case was the total difference in elevation between ends of lower sidewall headers more than ¼ in., and averaged about ⅛ in. In all runs, circulation began slowly and the temperature differences between headers and water contained never materialized.

Temperature differentials within the steam drum varied from the center to either end, with the ends running as much as 50 F lower during steady operation. However, at points around the circumference at a cross section the temperature differentials were never more than 20 F. The maximum difference between end and center was 105 F. Because no distortion of the drum structure occurred, no over-stress resulted. These observations were applicable to all runs.

After a few runs on this method, it was thought that a permanent thermocouple arrangement to measure the gas temperature entering the screen might serve as a control when fast-starting procedures became a routine operation. Study of test data indicated that if the gas temperature entering the screen did not exceed 1100 F, neither the high-temperature nor low-temperature sections became overheated when the superheater drain was partially opened. After a series of successful runs was made when operators proceeded from a standard instruction, it was decided to install a retractable thermocouple gas probe and indicating device for routine operation.

Conclusions

Fast-starting procedures result in lower stressing of the boiler structure as a whole, as shown by reduced measurements of distortion during the expansion period. These results are obtained because the relatively high gas velocity through the boiler passes provides more uniform distribution of gas flow across the unit. Temperature differentials between drum metal temperatures and water contained therein are reduced in the fast procedure because circulation is more rapid and uniform across the width of the drum. It is the author's opinion that the fast-starting procedures developed during this investigation are entirely practical and of considerable advantage with respect to strain that the boiler must be subjected to, time of attendance required and increased flexibility and dependability of boiler plant operation.

References

1. Jefferson Faulkner; Quick Starting of Large High-Pressure, High-Temperature Boilers, Paper No. 52-A-120, presented at ASME, 1952.
2. C. E. Morrow and R. F. Born; Fast Starting of 150,000-lb-per-hr Industrial Boilers, presented at American Power Conference, March 30, 1955.

$140 Preheater Eases Combustion Air Problem

Wrap-around preheater, fitted onto breeching, required no extra plant space

By C. D. STRATTON*

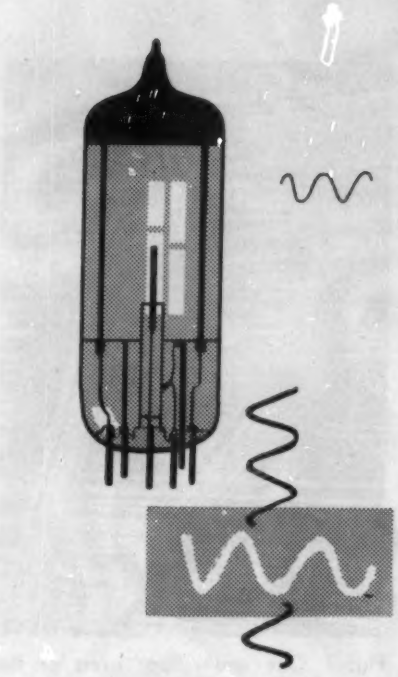
GRAND RAPIDS Store Equipment Company has a typical small boiler plant for the production of steam for heating and process purposes. Combustion air is drawn from this boiler room and fed into the furnace both as over-fire and under-fire air. During the winter months when this relatively-small boiler room is closed off, the normal leakage of air into the room is inadequate and the high vacuum produced makes combustion control very difficult.

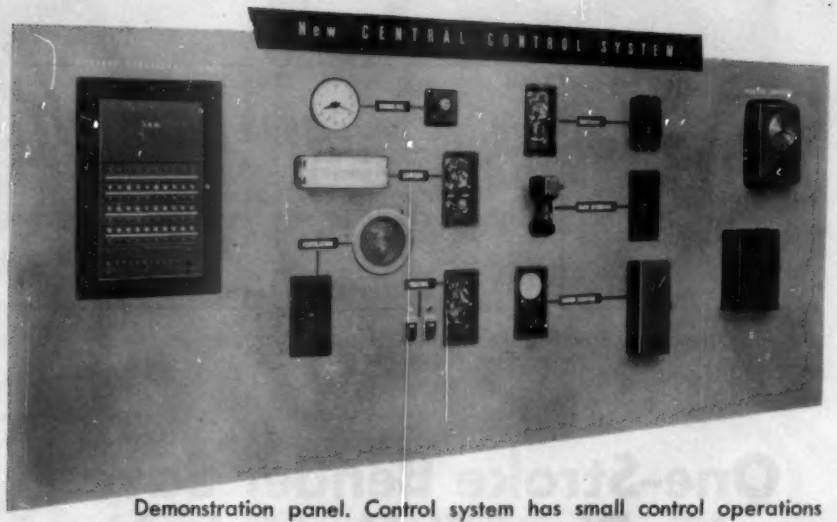
Obviously, the situation could be relieved by opening a window or door, but the low temperatures of Michigan winters would endanger the water and steam lines. Running a duct outside for introduction directly into the fan had draw-backs because of the chilling effect of outside air on the grates and furnace in general. An air preheater proved hard to justify to management, though this was the obvious solution to our problem. So we made our own.

Our home-made preheater consists simply of a sheet metal jacket covering three sides of the furnace breeching between the boiler house and the smoke stack. Air enters this jacket around the tops and ends of the vertical side plates, is pulled along the breeching, and enters an air duct at the bottom of the jacket. This duct enters the boiler house and terminates about a foot in front of the forced-draft fan inlet.

With this arrangement, outside air is tempered through contact with the breeching and is available at the fan inlet to make up the difference between normal leakage into the room and the combustion air requirements. With an outside air temperature of 10 F, air is supplied the fan at 50 F under normal operating conditions. The cost to us was about $75.00 for materials and $65.00 for installation, or a total of $140.00.

* Maintenance Engineer, Grand Rapids Store Equipment Co., Grand Rapids, Michigan.





Demonstration panel. Control system has small control operations cabinet, left, and individual control elements throughout plant

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- Start small and add standard plug-in units quickly as the need arises
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PUMPS, FANS, LIGHTS, any kind of machine, process or equipment can be started, stopped or cycled automatically by the new IBM Central Control System. Up to 40 functions can be handled by a single installation and as many as 10 events can take place simultaneously. Left alone the system will carry out a prearranged program every minute of the day, every day of the week.

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If you wish, you can lock off the automatic control from any single element for either a definite or indefinite period. You can set up a sequential load programming to limit your peak demand, or change over your heating load to dual thermostats to maintain minimum temperatures at night but comfort condition during working hours.

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Its most advanced application would be to start up and shut down production lines in automated plants, turning on the heat, lights, ovens, machines, etc., as needed for warm-up periods prior to the start of operations.

One department-store installation using 62 coded receivers cost approximately $8000, and the estimated annual savings is $8300 for the first year and about $8000 annually thereafter. About $2000 was saved in feeders and conduit by the remote location of the lighting panels, which did not have to be brought into the store area. The additional savings in operation are for electric power, roughly an hour and a half a day, cut-off lighting operation, and savings in fluorescent lamp replacements due to the reduced number of starts and stops.

A Texas hotel is said to be saving $1000 a month on peak demand charges alone, due to proper programming and shutting off non-essential loads for short periods during the former peak. In Kansas City where water costs are high, a proposed installation is estimated to save in the first year for wasted flushing water alone, its entire installation cost.

This new control system utilizes 60-cycle power and lighting circuits for the transmission of the supervisory signals.

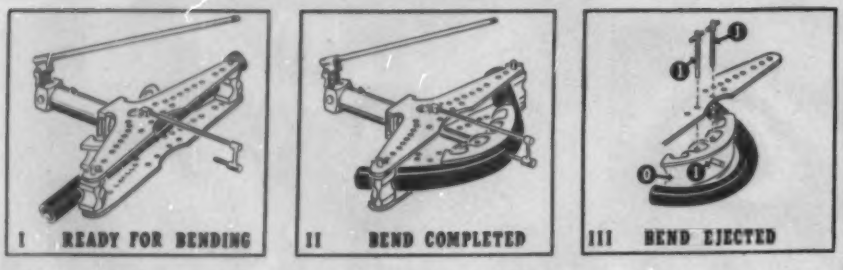


Fig. 1. Operation of one-stroke bender. Note gage extension, plunger ejector

One-Stroke Bender Saves Pipe, Fittings, Labor

Here is a bender (pipe, not pretzel) that saved the contractor a lot of dough. The "secret" is: make one setting, make one bend. See the table below for savings on the Narrows Dam job

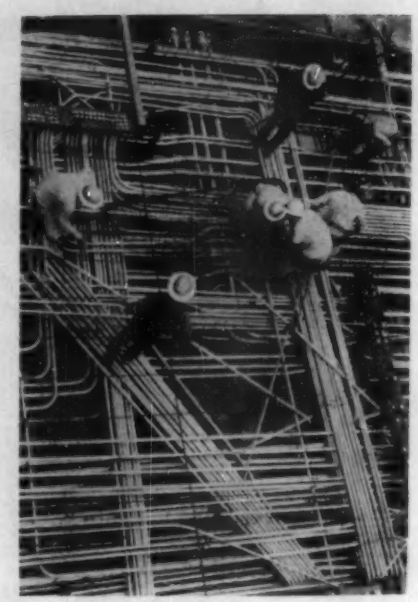


Fig. 2. One under-floor area of the Narrows Dam powerhouse, where data for installation costs were gathered

NARROWS DAM hydro-electric project provided a lot of distractions for everyone who worked on it — flash floods, foundation washouts, and cable-car breakdowns. While all this was going on, however, the electrical contractors were getting experience of a somewhat more valuable nature. They were trying out a new type portable bender on their conduit work, and the results were interesting enough to pass along to you (see table below). This bender, a small thing in itself, saved enough time for the contractors to meet their obligations despite the many unscheduled stoppages.

Basically, the portable bender (as illustrated in Fig. 1) consists of a manually-operated, long-stroke hydraulic ram with a close-fitting half-circle bending shoe. The half-circle shoe allows on-the-job bends up to 180 degrees with one setting, a gage stops the ram at the pre-set limit, and a plunger ejects the pipe from the close-fitting shoe in a separate operation.

Ten miles (over 51,000 ft) of one-inch to three-inch galvanized rigid conduit were used on the Narrows, and 1893 bends were required. Bend work was confined chiefly to three under-floor areas in the power house, each 30 ft square. Eight intricate layers of bent conduit (5500 ft) were installed in each. Most of the actual bending was done on location in these areas when the weather permitted, but was moved to a nearby shaded area when the temperature got too high. Long runs of lead cable comprised the balance of the job; these connected the switchyard, three powerhouse locations and three generator areas.

Over 900 man-hours and nearly $1000 materials savings were achieved. The figures compare the manual type bender with power cutting and threading costs since it was a study of the specific job. Comparisons between a power bender (with the same one-setting characteristic) and power cutting and threading might prove even more interesting. Also, no account was taken of the materials lost through cutting (short ends, etc.).

Table of comparative costs for installation of electrical conduit, Narrows Dam job

MATERIAL SAVING ESTIMATES

Size of Conduit (Inches)	Conduit Cost per Bend	Cost of Fittings per Turn	Material Saving per Bend	Number of Bends	Material Saving (Dollars)
1	0.32	0.61	0.29	612	177.48
1¼	0.50	0.86	0.36	840	302.40
1½	0.72	1.24	0.52	172	89.44
2	1.06	1.91	0.85	225	191.25
3	2.86	6.79	3.93	44	172.92
Totals				1,893	933.49

TIME SAVING ESTIMATE

Size of Conduit (Inches)	Bending, Measuring, and Installing— (Manual) Minutes per Bend	Measuring, Cutting, and Fitting— (Power) Minutes per Turn	Time Saving per Bend (Minutes)	Total Number of Bends	Total Time Saving (Hours)
1	25	50	25	612	255
1¼	35	65	30	840	420
1½	40	70	30	172	86
2	45	75	30	225	112
3	60	105	45	44	33
Totals				1,893	906

IF YOU want more information on this gadget, write us on your letter-head or jot "Pipe Bender" on the prepaid card in this issue.

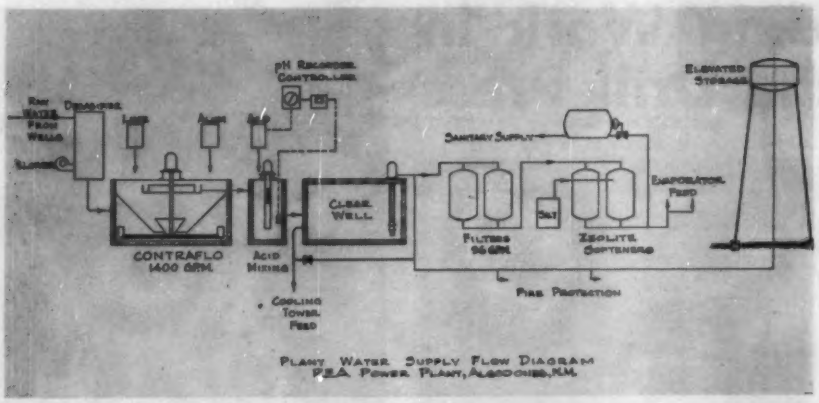


Fig. 1. Algodones plant water supply system treats about 4500 gal per minute of raw well water. About 80 per cent of this water goes to two cooling towers

By VINCENT M. ROACH*

How a New Mexico Power Plant Handles Well Water

Supplying electricity to thousands of people on ranches and rural communities in New Mexico depended on adequate water supply; here's how Algodones uses well water to generate 30,000 kw

Fig. 2. Modern building of concrete block and aluminum dominates landscape

IN AUGUST, 1954, the Plains Generation and Transmission Cooperative completed a new two-unit 30,000 kw steam turbine plant at Algodones, N. Mex.

Plant water is pumped from three wells into a degassifier which removes free CO_2 and raises pH so system needs less lime. Water then flows into concrete Contraflo where it is softened by lime process. Clarified effluent flows into mixing tank where acid is added automatically to maintain pH.

About 80 per cent of this basic water goes to two cooling towers; here chlorine is added and additional acidity supplied for correct pH. Remainder goes to clear well and is pumped to the elevated storage tank as utility water.

Boiler water from storage is filtered and zeolite softened; for sanitary use, filtered, softened water is chlorinated.

*Chief Engineer, General Filter Co., Ames, Iowa

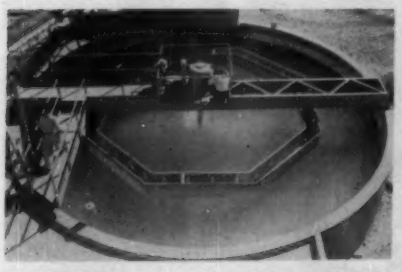


Fig. 3. Contraflo tank holds 126,000 gal of water for softening with lime and alum. Conveyor for chemicals, left

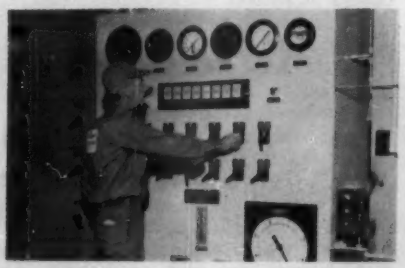


Fig. 4. Control panel of the treatment system shows extensive instrumentation used to regulate treatment operations

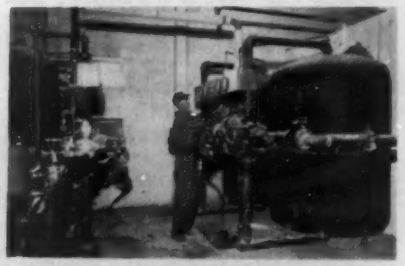


Fig. 5. Twin zeolite softeners can be controlled easily by only one operator of 18-man force that runs entire plant

Tips on Holding Work in the Drill Press

By F. E. RILEY

SENSITIVE pillar type drill presses are standard pieces of maintenance shop equipment which are used by anyone who wishes to drill holes up to ½ in. diameter. Because the machines are for general use, they are not usually provided with much in the way of auxiliary tools and equipment, with the result that their efficiency is impaired.

One of the greatest causes of misuse and slowness of operation on the average shop drill press arises from the lack of work-holding equipment. Jobs are gripped in the hand, held with pliers and otherwise secured with makeshift devices which often lead to broken drills, scrapped work and injury to the machine operator.

A typically dangerous piece of work which should never be gripped by hand, shown in Fig. 1, is a flat steel strip of a thickness less than the drill diameter. It will tend to catch on the drill, when this is breaking through the underside, so that it will be whirled around in an alarming and dangerous manner unless means are provided to positively prevent it.

Holding Thin Work

The remedy is also shown in Fig. 1 and will be seen to comprise a pair of light C-clamps of standard type which have been filed down in width on the frame to permit passing through the elongated slots in the machine table.

The clamps can stay in position on the machine table for long periods and are adaptable for holding a wide range of work pieces. For instance, the clamps shown will grip work up to 2½ in. thick. They can be slid along the slots in the table until the solid anvils are touching one another, thus holding work which is small in top area. The clamps are prevented from dropping out of the table slots by means of a split cotter pin passing horizontally through a hole drilled in the frame of each of them. The button on the end of the clamp screw, underneath the table, spans the underside of the table slot, but can often be improved if the surface area is increased by welding on a thick washer of large diameter. A pair of clamps of the type shown in Fig. 1 can form a permanent piece of equipment for any shop drill press; they can be used with great speed and convenience since there are no separate bits of packing to manipulate.

One of the difficulties associated with providing auxiliary equipment for shop drill presses arises from the tendency of workers to "borrow" the drill press equipment and to forget about returning it. Every drill press should be equipped with a work holding vise, in the interests of safety and convenience. One very good way of providing a vise permanently fixed to the machine table has been to build in a vise on the underside of it. The top surface of the table is always clear for large and heavy jobs. To use the vise, the table can be swivelled on a horizontal pivot through 180 degrees to bring the vise uppermost and in the operating position. The moving vise jaw is on its own pair of guides and a second set of guides is provided to enable the vise and the work in it to be moved transversely across the machine to bring such things as center punch marks in the work in alignment with the drill point. Adjustment of the work to right or left of the drill point is achieved by swivelling the table on the vertical pillar of the machine. Such a vise is permanently attached to the machine and cannot be "borrowed". A further advantage of fixing the vise is in eliminating the danger of whirling under the action of a drill which has caught the work.

A simple method of preventing vises mounted with one bolt from whirling is illustrated in Fig. 2. A horizontal hole is drilled and tapped into the fixed jaw end of the vise and into this is screwed a piece of steel rod which has been bent to an L-shape. The downward projecting leg of the L passes through one of the machine table slots and thus acts as a stop to discourage whirling. If the vise is to be moved freely to any part of the table not convenient for

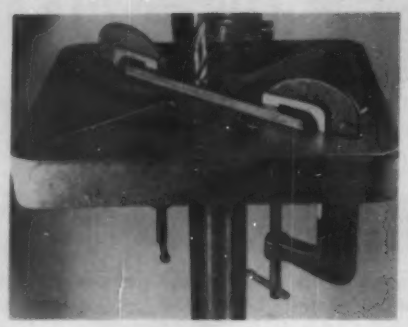


Fig. 1. C-clamps with ground-down webs make a handy retainer. Cotter pins prevent clamps from slipping through table

Fig. 2. Bent steel bar tapped into the fixed jaw and inserted in table slot is used to prevent whirling of engaged vise

Fig. 3. Parallel strips adjacent the jaws raises the work-piece so drill can pass through. Wadded paper steadies strips

Fig. 4. Thin work rests on top of vise and is clamped by machined flats on heads of set screws tapped into jaws

Fig. 5. Modified tap (foreground) can be gripped in chuck, work in vise, for hole alignment. Tap is turned in by hand

intersecting a slot, the leg of the L can be turned upward, clear of the table top.

A further development of this idea is to thread the end of the downward projecting leg and on this to lock in place a hexagon nut. This will effectively prevent the vise from being removed from the machine. Proportions of the bent rod can be adjusted so that the vise hangs clear of the table surface at the back if the table is needed to be kept clear. It will be found that the L-shaped stop does not interfere with the alignment with the drill point of center punch marks on work, since the combination of adjustments obtained from swivelling the table about the pillar and sliding the stop in the table slots will cater for most vise-held jobs.

Holding Thin Work

To hold thin work for drilling, it is customary to arrange a pair of parallel strips which will support the work at the edges and leave a clear passage for the drill when it has gone through, as illustrated in Fig. 3. This method is applicable to any vise work where it is necessary to raise the working plane of the work piece for proper tool engagement, as in normal shaping and milling machine work.

Holding thin work of irregular or circular shape is another problem encountered in drill press vise work. A typical example is the washer shown in Fig. 4 which also illustrates a useful modification to a vise which does not have hardened jaws. The modification comprises drilling and tapping a series of ¼-in. holes along the top surface of both jaws. Four headless set screws, which have modified ends, are screwed into the tapped holes. These screws have a pair of opposed flats filed on, and have a depth of about ⅛ in. The flats serve the dual purposes of providing a finger grip for inserting the screws and also form bearing surfaces for abutment against the work.

In use, the thin piece of work rests on the tops of the vise jaws, thus doing away with parallel strips. The work is gripped by the screws which protrude above the tops of the vise jaws, the flats on the screws bear on the work edge, to which they fit themselves automatically. It can be seen that three screws will suffice for gripping circular plates. With two screws in each jaw, very odd-shaped pieces of work can be gripped for drilling by the four points thus formed. It is essential that the moving jaw of the vise be of the swivelling type, as shown, so that the four holding points can make contact with the edges of the work, no matter what its shape. When the vise is to be used for the normal run of work, the screws can be protected against loss by screwing them down into their holes so that they are below the jaw top surfaces.

This vise modification is applicable to the holding of thin washers and plates which have to be filed or otherwise worked on the surface. The holding screws can be adjusted for height above the vise jaws so that work pieces about 1/16 in. or so in thickness may be held firmly without the screws protruding above the work's top surface.

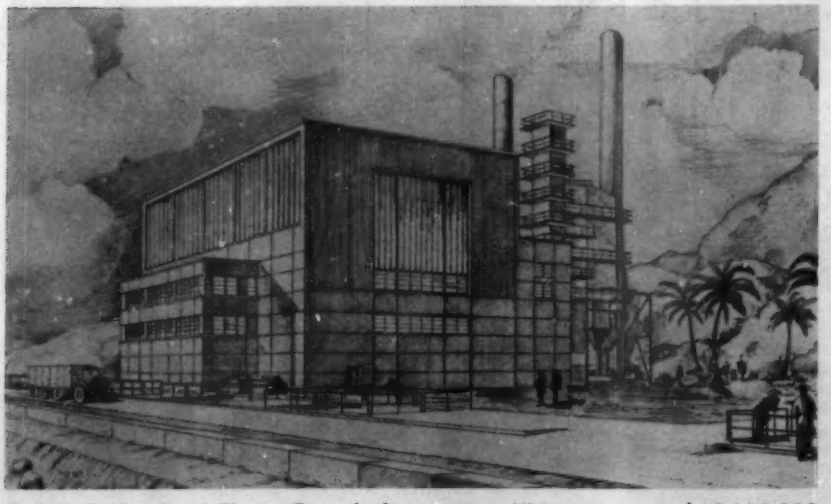
Starting Taps

Allied to the advantages of clamping the vise to the machine table for drill work, the drill press and vise help to give taps a true start. After the hole is drilled, the tap can be gripped in the drill chuck for starting the thread, with assurance that the tap cannot tip out of line with the hole axis. It is, however, of no avail to grip the tap shank in the drill chuck and expect the power drive of the spindle to be used for cutting the thread. In most cases, the top shank will slip in the chuck no matter how hard it is tightened; also, the average drill press speeds are too high for tap driving. It is better to drive the tap with the normal hand wrench and to utilize the drill press spindle and chuck only as guides and supports.

A method of doing this successfully is illustrated in Fig. 5 and entails modifying the taps in the manner illustrated by the tap in the foreground. A pair of flats at a right angle to one another are ground on the shank just above the threaded portion so that the standard wrench can be engaged therewith for turning it by hand. A length of plain shank then protrudes above the wrench and this can be gripped in the chuck jaws.

In use, the tap is chucked with the wrench in place, and the machine spindle is fed down to present the tap to the drilled hole. While exerting downward pressure on the spindle with one hand, the tap is given a start by turning the wrench with the other. The machine quill is then locked against vertical movement and, provided that the chuck jaws are tightened lightly, the tap can then be screwed into the work by using two hands on the wrench. As the tap feeds downward, it pulls itself through the lightly gripping chuck jaws. The hole may be tapped completely while guided by the machine spindle, but if the hole is deep it may be necessary to feed the spindle down and take a new hold with the chuck on the tap shank.

Caracas, Venezuela, Gets New Power Plant



Architect's sketch of Planta Tacoa's first section. Ultimate cost is $45,000,000

VENEZUELA'S capital city will soon have a new power plant with an ultimate capacity of 320,000 kw. C. A. La Electricidad de Caracas, which serves the capital city, now has a nameplate capacity of 112,000 kw. The new project, "Planta Tacoa," will install two 40,000-kw units for operation by September 1955; four additional 60,000-kw units at some future date. The Kuljian Corp. of Philadelphia will design and construct the building for the first two units.

Turbine-generators, condensers and auxiliaries, feed pumps and feedwater heaters are by Brown-Boveri & Co., Ltd. Outdoor steam generating units will be furnished by Babcock & Wilcox, Ltd. The main step-up transformer is by Le Materiel Electrique S-W, Paris; electrical equipment by Westinghouse International Co. and International General Electric.

Power Engineering handbook

Three-Wire D-C Generation

By RALPH R. TAGGS

THREE-WIRE direct-current distribution, generally of 125/250 volts, is used extensively in industrial plants where electric power is generated, and in many other plants where alternating current is converted to direct current. The many advantages of direct-current over alternating-current motors in industrial applications, the saving in copper costs with 250 volts over the 125 volt, two-wire system justifies the use of a three-wire system.

The armature of *every* commutating d-c generator has an alternating voltage induced in it, and direct current is obtained through the utilization of brushes and a commutator. Alternating current can likewise be obtained from a d-c armature by connecting the windings to collector (slip) rings and through brushes to the external circuit, or load.

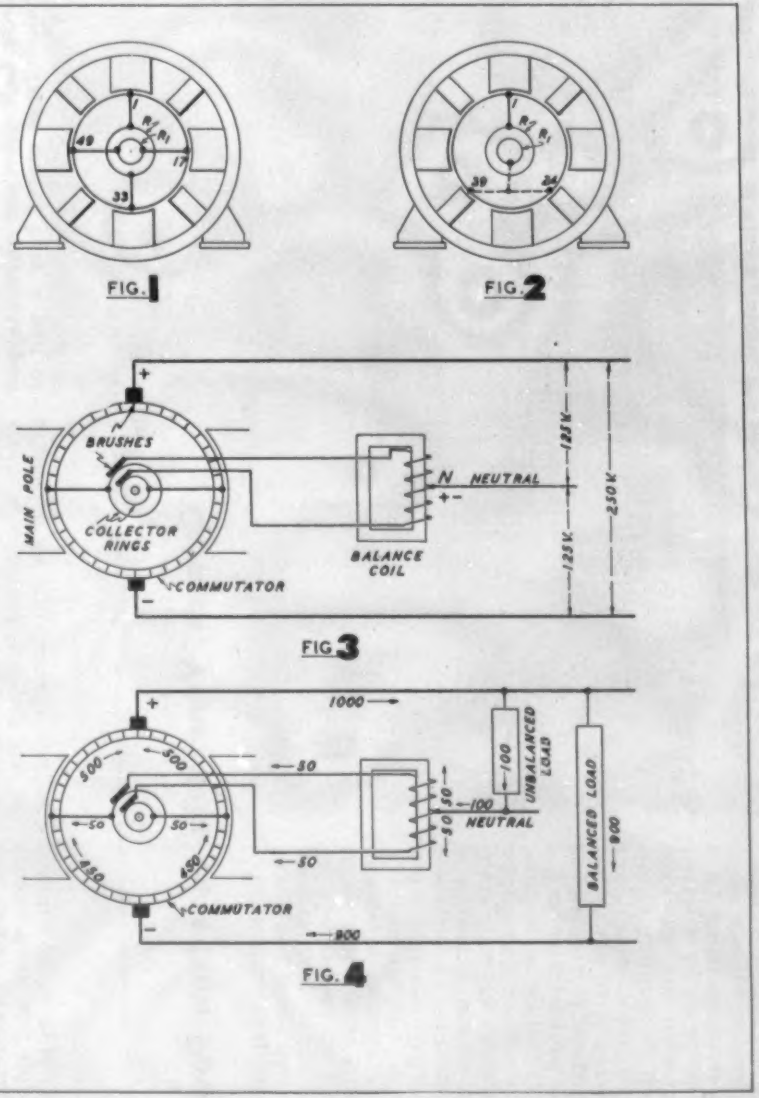
On a simple three-wire direct-current generator, two collector rings are added to the machine, and these are electrically connected to the armature winding to give single-phase, alternating current. The voltage of this circuit as indicated by a voltmeter will be 70.7 per cent of the d-c voltage of the generator. This is the "root-mean-square" value of the induced sine wave. Its frequency, in cycles per second, is equal to the generator speed in rpm times the number of main (shunt) poles, divided by 120. A machine of 1800 rpm and provided with four poles would develop a frequency of 60 cps.

There can never be more connections from the armature winding to each ring than there are points of equal potential on the armature. With a multiple winding, there can be as many connections per ring as there are pairs of main poles. With a two-circuit wave winding, there can be only one connection per collector ring, irrespective of the number of pairs of main poles. Since two collector rings provide single-phase alternating current, the connections to the two rings must be 180 degrees apart, electrically. This is illustrated in Fig. 1 for a multiple-wound armature, and in Fig. 2 for a wave-wound, two-circuit armature.

A balance coil consists of a single continuous winding on a laminated iron core. When such a coil is connected to the collector rings of a three-wire generator, as in Fig. 3, its middle point provides a neutral conductor for the three-wire system. If two direct current voltmeters are connected from point N, the middle tap of the balance coil, to the positive and negative conductors, respectively, voltages equal to one-half that across the commutator brushes will be evidenced.

Some manufacturers instead of providing two collector rings with brushes and an external stationary balance coil, build the balance coil into the spider of the armature so that it can rotate with the armature. In such cases only one collector ring is necessary, but this ring and the brushes must be twice the capacity of either of the rings where two rings and an external balance coil are

fold along this line — outside edges toward you



used. Other manufacturers place the balance coil winding in the slots with the armature winding. These slots, of course, must be deeper than if the winding were not there. The objections to these two types of construction are that the neutralizing coils are located in space that could be more advantageously used for generator capacity (output). Repairs and preventive maintenance are also more difficult and costly to make. A failure of the balance coil winding neces-

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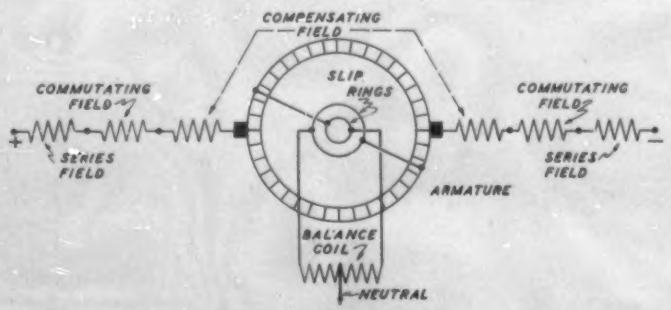


FIG. 5

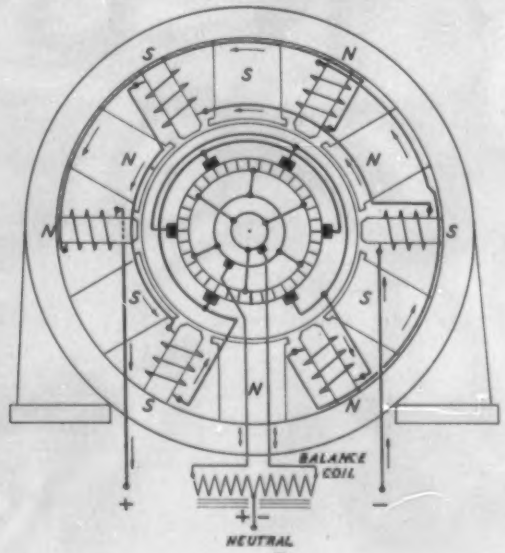


FIG. 6

sitates the removal of the entire machine from service for that time required to repair or replace the winding.

Figure 4 shows diagrammatically a three-wire generator serving a balanced load and an unbalanced load simultaneously on the positive side of the system. The figures at the arrows indicate the magnitude and direction of current flow under the assumed conditions of loading (whether amperes or kilowatts). Two currents exist in the balance coil simultaneously. One is a small alternating current (not indicated on the diagram), which acts as a magnetizing current for the coil and provides the neutral point. The other is a direct current (the unbalanced load current), which enters the balance coil at the mid-point and divides, approximately half flowing in each direction through the coil to the armature. The actual division depends upon the rotating position of the tap to the collector rings in respect to the direct current (commutator) brushes. In Fig. 4 the current divides one-half to each side.

When a generator's load is unbalanced, the voltage on the more heavily-loaded side drops slightly due to I^2R losses, and that of the other side increases, since the sum of the voltages on each side of the neutral must equal that between the two main conductors.

If the connections from the collector rings to the armature coils are not correctly made, and more coils are included between taps on one side of the armature and the collector rings than on the other, the emf on the two sides of the system will be out of balance and *any lighting connected to the neutral wire will flicker.* Ordinarily, with the load out of balance equal to 25 per cent of the rated capacity of the machine, the voltage difference between the neutral and the outside wires will not exceed 1.5 per cent of that between the outside wires.

Twenty-five per cent of the rated current of the generator is considered the maximum unbalance permissible. If the unbalanced current is greater than this, commutation will be impaired due to unbalance in the commutating magnetic circuit. The armature conductors connected to the commutator bars passing under the brushes carrying the greater current will require a stronger commutating field than the conductors connected to commutator bars passing under the brushes carrying the lesser current. Neglecting leakage, all commutating poles will be of the same relative strength under any unbalanced condition.

To arrive at uniform strength of field poles, the commutating-pole field and the compensating-field windings, when used, are divided and one half of the coils are connected to the positive side of the armature, and the other half to the negative side. This is indicated in Figs. 5 and 6. Not only is it necessary to connect half of these coils on one side of the armature and half on the other side, but all *south* poles must be on one side and all *north* poles on the other. If not, some of the commutating poles will not have a magnetic flux through them when the load is all on one side of the system.

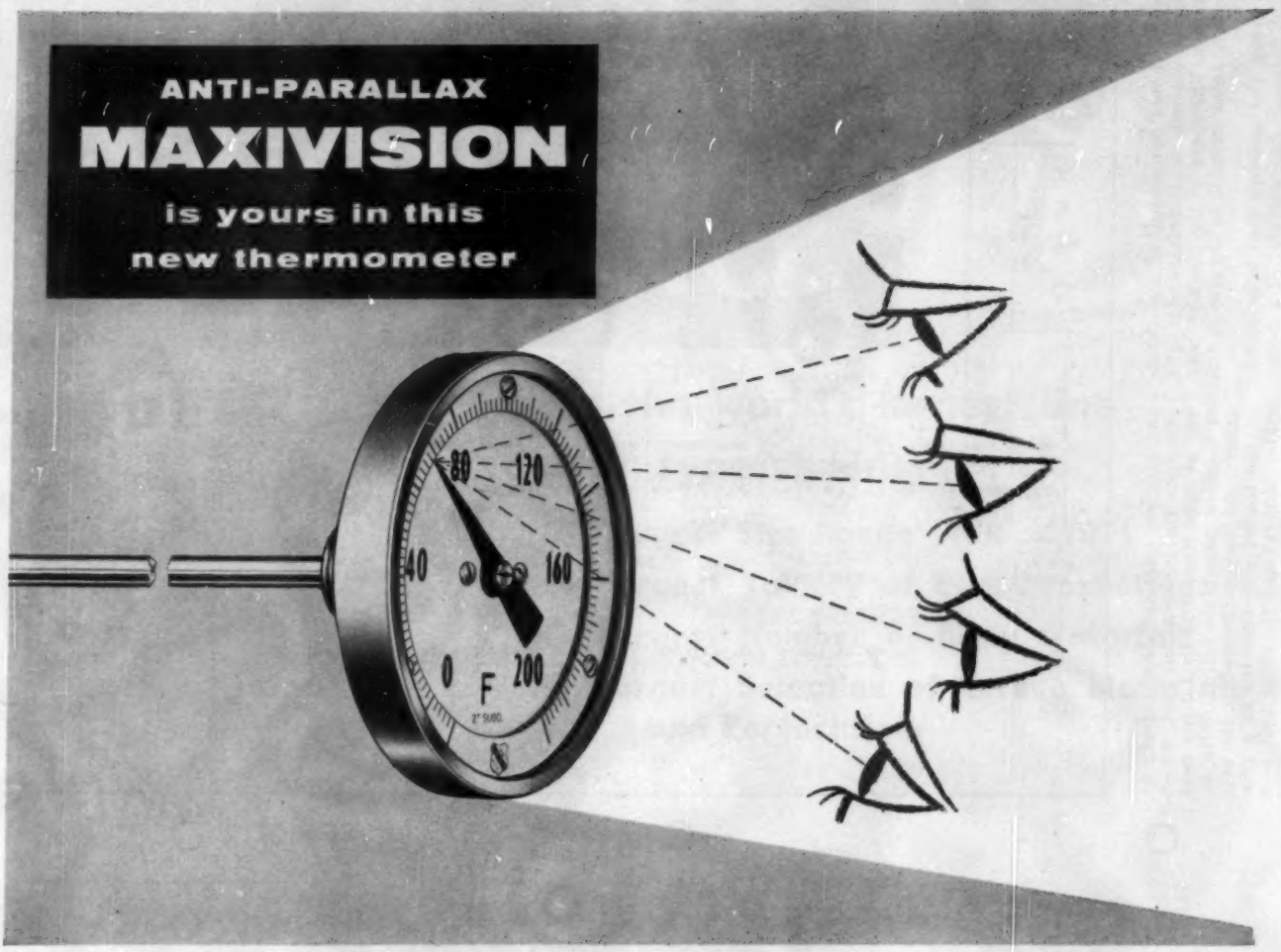
This can be readily understood by reference to Fig. 6. The commutating-pole flux passing from any one pole into the armature can be considered as dividing, each half passing through the armature in opposite directions and returning to two adjacent commutating poles and the generators. The series-field winding, when one is used (compounded), must also be divided in a similar manner, so that proper compounding will be obtained irrespective of loading on the generator. No change is necessary in the shunt field or its connections for use on a three-wire generator.

Parallel operation of three-wire generators differs slightly from that of the two-wire type, although the principles involved are the same. Since there are two series fields, two equalizers must be used, as well as two equalizer switches (or breakers). The neutrals are also paralleled, requiring the application of neutral disconnects.

Two ammeter shunts are also required for each machine, and connected *inside* the equalizer connections. If the shunts were located at the switchboard, the ammeters would indicate not only the distributed load currents, but also any equalizing currents flowing between generators. This can be considerable at times. The unbalance current is the difference between the negative-line ammeter reading and the positive-line ammeter reading. Figure 7 is an elementary diagram of two three-wire generators connected in parallel. When paralleling these machines, and after the voltages are equal, close the neutral switch (2p) first, then the equalizer switches, and finally the line breakers.

Multi-Dynamo Balancer Sets

There is a method of securing three-wire service from a standard two-wire d-c generator by using a balancer pair as illustrated in Fig. 8. The balancer set consists of two duplicate (generally compound-wound) direct-current machines coupled together mechanically and mounted on a common bedplate. The voltage rating of each is one-half that of the main generator, and the current



Now you can read temperatures *right at the process* with the same ease, accuracy and economy as pressure readings. The Anti-Parallax Maxivision Dial on this new all stainless steel American Bi-Metal Thermometer assures these important advantages. The large, easy-to-read black figures and graduations are carried on a raised ring set close to the glass, with pointer at the same level. Parallax error is practically eliminated.

With this new thermometer in service, field operators can eliminate frequent trips to the control house to observe process changes. Indoors or outdoors, this fine, all stainless steel American instrument is truly climate-proof. Because the case is only 3" in diameter, the thermometer fits where space is limited. Ample clearance behind the case makes installation easy and fast with a small wrench. Read the specification highlights, then get full details about this new high-accuracy American Bi-Metal Thermometer.

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SPECIFICATIONS

New AMERICAN ALL-STAINLESS STEEL BI-METAL THERMOMETER with ANTI-PARALLAX MAXIVISION DIAL

Dial: Exclusive anti-parallax Maxivision dial, with scale approximately 6" long. Pointer set at same level as scale.

Climate-Proof Case: All stainless steel. 3" diameter. Threaded bezel. Selected clear, extra-heavy cover glass. Heat-resistant gaskets between glass and case seal the thermometer against rain, frost, sand, dust, fumes—climate-proof.

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range.

Low-Mass Bi-Metal Coil: Welded to stem plug. Accurately centered in stem. Non-freezing, non-corrosive silicone fluid on coil dampens vibration, accelerates heat transfer, speeds response; does not gum, resists capillary action.

Pointer: Index type. Easily accessible from front of dial for positive adjustment over entire range. Pointer shaft guided by friction-free bearings.

Stem: 18-8 stainless steel, mirror polished. All joints welded. Resists corrosion. Provides strong, rigid and tight closure against process pressures. Lengths: 2½" to 24".

Connection: Fixed, ½" N. P. T.

Separable Sockets: Available for use in closed systems or where measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".

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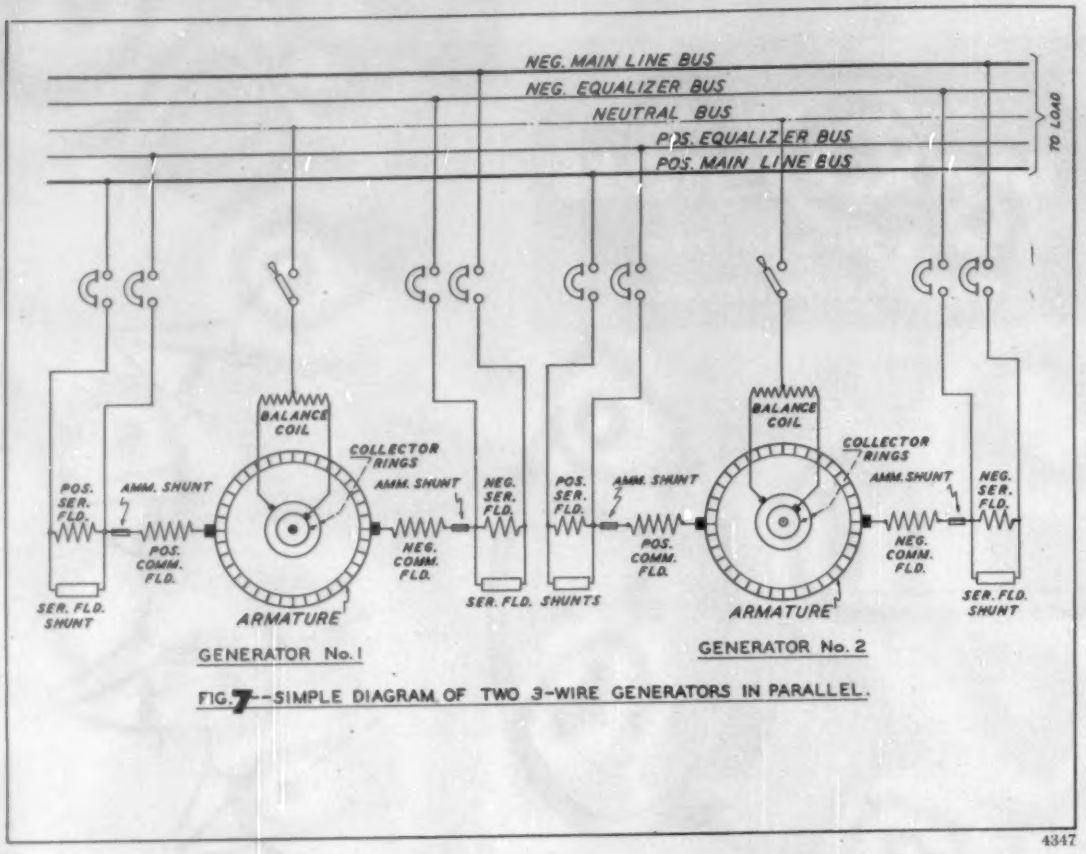

FIG. 7--SIMPLE DIAGRAM OF TWO 3-WIRE GENERATORS IN PARALLEL.

rating should be one-half of the unbalanced current contemplated for the system. The speed of the machine may be any value suitable to the size of the units.

When the system's load is balanced, each balancer unit operates as a motor and requires only sufficient current to overcome the losses at no load, which will average from 0.05 to 1.0 per cent of machine nameplate rating. With an unbalanced load on the system, the unit on the loaded side operates as a generator (driven) and the other unit as a motor (driver). As indicated in Fig. 8, each unit has the same current coursing through its armature, and this would be true were there no losses in the units. There are losses in each machine, however, and the potential across the generator side will be less than that across the "motor" side. The current through the "motor" side will be greater than the current in the generator side, inversely in proportion to the voltage on each unit. By crossing the series and shunt-field windings of each unit, as shown in Fig. 8, less unbalance of voltage occurs. The "generator's" shunt and series fields will be strengthened, which will tend to raise its voltage. The "motor's" field will be weakened and will tend to increase in speed, thus increasing the output voltage of the generator unit — and more nearly equalizing the voltage on each side of the neutral.

The principal disadvantages of the balancer sets are the higher initial cost, greater operating losses and the constant maintenance required. The main advantage lies in its easy adaptation to existing two-wire units to obtain three-wire service. In this type of system the percentage unbalance of the load is limited only by the size of the rotary balancer set.

By taking all the above factors into account, you can obtain satisfactory results.

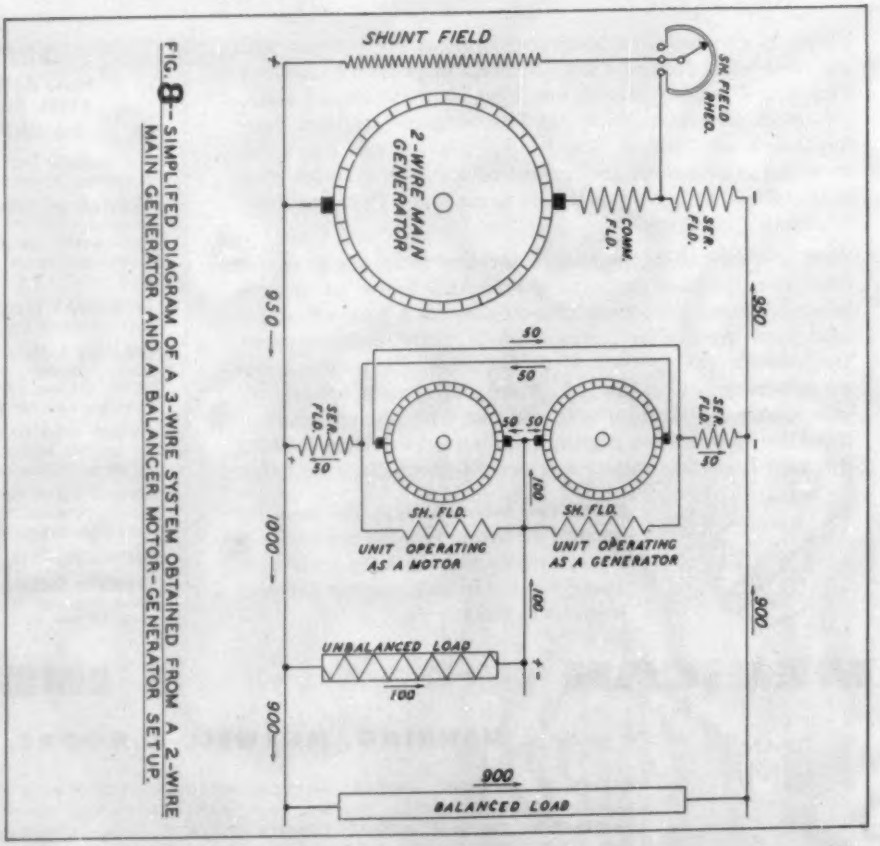

FIG. 8--SIMPLIFIED DIAGRAM OF A 3-WIRE SYSTEM OBTAINED FROM A 2-WIRE MAIN GENERATOR AND A BALANCER MOTOR-GENERATOR SETUP.

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WIRE - CONVERSION FORMULAE

CIRCULAR MIL IS A TERM UNIVERSALLY USED TO DEFINE CROSS-SECTIONAL AREAS OF CONDUCTORS, BEING A UNIT OF AREA EQUAL TO THE AREA OF A CIRCLE ONE MIL IN DIAMETER. THE CIRCLE, HOWEVER, HAS AN AREA OF .7854 OR $[\pi/4]$ THAT OF A SQ. MIL. THUS, A WIRE 100 MILS IN DIAMETER HAS A CROSS-SECTIONAL AREA OF 10,000 OR 7,854 SQUARE MILS. :

CIR. MIL AREA X .7854 = SQ. MILS

SQ. MIL AREA X 1.27323 = CIR. MILS

CIR. MILS SQ. IN. X 1,273,200 = SQ. MM. X 1,973.5

CONVERSION OF COPPER TO ALUMINUM - AND FROM ALUMINUM TO COPPER CONDUCTORS IN COMPUTING FOR COMPARATIVE [OR EQUAL] CURRENT-CARRYING CAPACITIES:

CIR. MIL AREA OF COPPER X 1.185 = ALUMINUM CONDUCTOR

CIR. MIL AREA OF ALUMINUM X .84 = COPPER CONDUCTOR

TO OBTAIN THE DIA. OF CONCENTRIC-LAY STRANDED CONDUCTOR, MULTIPLY THE DIA. OF A SOLID WIRE OF THE SAME CROSS-SECTIONAL AREA BY THE FACTOR GIVEN IN FOLLOWING TABLE:

NUMBER OF WIRES:	FACTOR:	NUMBER OF WIRES:	FACTOR:
3	1.244	91	1.153
7	1.134	127	1.154
12	1.199	169	1.154
19	1.147	217	1.155
37	1.151	271	1.156
61	1.152		

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cut along this line

A. W. G.

THE BASIS OF THE AMERICAN WIRE GAGE IS A SIMPLE MATHEMATICAL LAW. THE GAGE IS FORMED BY THE SPECIFICATION OF TWO DIAMETERS AND THE RULE THAT A GIVEN NUMBER OF INTERMEDIATE DIAMETERS ARE FORMED BY GEOMETRICAL PROGRESSION.

THUS, THE DIA. OF A No. 0000 IS DEFINED AS 0.460 IN., AND OF No. 36 AS 0.005 IN. THERE ARE 38 SIZES BETWEEN THESE TWO: HENCE, THE RATIO OF ANY DIAMETER TO THE DIAMETER OF THE NUMBER IS GIVEN BY THE EXPRESSION:

$$\sqrt[40]{\frac{0.4600}{0.0050}} = \sqrt[40]{92} \quad 1.122\ 932\ 2 \quad \textit{AND:}\ 1.122\ 932\ 2^2 = 1.2610 \quad \textit{AND:}\ 1.2610^6 = 2.0050$$

THE FACT THAT THIS RATIO IS SO NEARLY "2" IS THE BASIS OF NUMEROUS USEFUL RELATIONS OR SHORT CUTS IN WIRE CALCULATION; THE SIXTH POWER OF THE RATIO, *I.E.*, THE RATIO OF ANY DIA. TO THE DIA. OF THE SIX GREATEST NUMBER = 2.0050.

THE FOLLOWING APPROXIMATE RULES ARE APPLICABLE TO THE A.W.G.:

1. AN INCREASE IN THREE GAGE NUMBERS DOUBLES AREA & WT. & HALVES D.C. RESIST.
2. AN INCREASE OF SIX GAGE NUMBERS [E.G. FROM No. 10 TO 4], DOUBLES THE DIA.
3. AN INCREASE OF TEN GAGE NUMBERS [E.G. 10 TO 10], MULTIPLIES THE AREA AND WT. BY 10 AND DIVIDES THE RESISTANCE BY 10.
4. A No. 10 WIRE HAS A DIAMETER OF APPROX. 0.10 IN., AN AREA OF APPROX. 10,000 CIR. MILS, AND, [FOR STD. ANNEALED COPPER AT 20°C.], A RESISTANCE OF 1.0 OHM PER 1000 FT.

FUSING [MELTING] CURRENTS FOR DIFFERENT KINDS OF ROUND WIRE ARE CALCULATED BY THIS FORMULA:

$$I = KD^{\frac{3}{2}} \quad : \textit{TIME: [1 SECOND]}$$

WHERE I = FUSING CURRENT D = DIA. OF WIRE IN INCHES $\frac{3}{2} = 1.5$ AND K = CONSTANT AS INDICATED BELOW:

COPPER	10,244	GERMAN SILVER	5,230	TIN	1,642
ALUMINUM	7,585	PLATINOID	4,750	ALLOY [2 Pb-1 Sn]	1,318
PLATINUM	5,172	IRON	3,148	LEAD	1,305

By RALPH B. TAGGS

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

Volume 3 | APRIL 1955 | Number 2

It Takes a Lot of Water Conditioning To Deliver the Kilowatts

Current expansion in the public utility field to supply industry with more power and to bring electrification to greater areas demands careful planning for future water requirements, as well as active attention to existing water uses. Experts in utility station management turn to experts in water management for continuing consultation on water treatment and control.

Hall Laboratories now performs this service for some three hundred utilities, many of them on a system-wide basis.

Design of New Facilities

Constructors of a new utility plant on the West Coast made use of Hall's headquarters engineers in a three-way consultation to centralize information on: water availability and requirements from the plant; water characteristics from Hall field engineer E. R. Lang; and plant design from the constructors. A realistic report on cost and operation of suitable pretreating equipment resulted from the analysis.

The station has recently started operation with continuing supervision of water conditioning practice by Hall Laboratories.

Tailoring Water to Fit a Plant

Another western utility, whose existing plants were operating with Hall Service, withheld a final decision on the location of a new station until an adequate water supply could be developed.

Again, working with the constructors and the client, Hall Laboratories first analyzed samples from all available sources over a time period calculated to include representative conditions throughout the year. One sample was even taken during a flash flood, and provisions made for such extreme conditions.

With the data thus collected and the information on system requirements from the client and constructors, Hall staff engineers S. R. Osborne and A. M. Henricks went to work on recommendations for water treatment facilities. A detailed report covered preparation of water for: recirculating cooling water; cooling water for bearings; feedwater to the evaporator and drinking water. The Hall report included estimated comparative costs of alternative chemical treatments and diagrams indicating all equipment with specifications of capacities to simplify study of the various alternatives.

This power station has just gone into operation with Hall field engineer R. M. Tarr on the job to help plant engineers and chemists set up the exact conditions they need for the best operation of their new facilities.

Minimizing Treatment Costs

In other cases, plant surveys by qualified water-treatment engineers can obviate the purchase of costly equipment.

Hall engineers J. E. Summerville and M. C. Scott worked on a problem of this kind with a southeastern utility plant supplying a large rural area. The plant drew its water from three wells. Soluble iron and iron bacteria in the well water caused iron deposits in the plant water lines, recirculating cooling system and heat exchangers. Lines carrying cooling water to bearings had to be cleaned every three months to prevent complete plugging. Plugging of oil coolers occurred.

Iron removal would have involved a capital expenditure of $20,000 to $25,000 for equipment plus an annual chemical cost of $15,000 to $19,000. When Summerville and Scott estimated comparative cost of $1800 for equipment and $8000 for chemicals to control iron by Calgon® treatment, the plant deferred consideration of the pretreatment facilities.

Later reports showed that the co-operation of the plant personnel in carrying out the recommendations for controlling the iron and organic growths in the system had paid off. The water side of the condenser was free of deposit, the cooling tower was in good shape and oil coolers no longer plugged. Organic growth was under control.

* * *

Delivering kilowatts to all types of customers is the business of electric power stations. By adding the broad experience of Hall Laboratories to the specific knowledge of their own technical staffs, these companies feel better prepared to keep water troubles from interfering with production of power.

Boiler Feedwater Studies

Hall Laboratories participated in two papers sponsored by the Joint Research Committee on Boiler Feedwater Studies and presented at the 1954 annual meeting of the American Society of Mechanical Engineers in New York. M. D. Baker of West Penn Power Company and V. M. Marcy of Hall reported on "Hydrazine As An Oxygen Scavenger—A Progress Report on Tests at Springdale Station." J. D. Ristroph of Virginia Electric and Power Company and E. A. Yorkgitis of Hall presented a paper on "Controlling Iron and Copper Pick-Up with Neutralizing Amines." Preprints of the papers are available in limited quantities from the A.S.M.E. under No. 54-A-271 and No. 54-A-262, respectively.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

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Application Problems Important in Feedwater Heaters

SOLUTION of practical application problems in the dependability of feedwater heaters is sometimes far more important than providing highest thermal efficiency, power plant engineers were told, at the ASME annual meeting, by S. M. Arnow, Philadelphia Electric Co.

He said he was convinced that it is far less important that a heater have the exact number of tubes than that it have the exact number of vents at the proper places to prevent the tubes from corroding; that it is less important to place the heaters at the exact theoretical point in the cycle than to be sure that the joints do not leak with any fluctuation in load; that it is less important that certain terminal differences be maintained than that impingement baffles, stay rods and spacers remain intact and in place, or that heaters drain properly at all loads.

Several instances were cited to indicate that manufacturers of feedwater heaters must pay attention to the "common-sense, mechanical aspects of heater design," as well as to the theoretical problems of heat transfer, specific conductivity, etc., in order to assure equipment that works continuously, unobtrusively and trouble-free. These include such requirements as suitable material, protection against direct impingement on tubes by steam and flashing drains, provision for avoiding corrosive gas accumulations, proper location of vents, more attention to mechanical details, and careful study of all failures in order to determine the causes and to provide the cures.

Copies of the paper, No. 54-A-129, may be obtained at 50 cents each from Order Dept., ASME, 29 W. 39th St., New York 18.

"He always stops to take charge when we are dismantling, but he's always busy when we assemble the machine."

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Savings start with *Powermaster's* simplified installation whether single or multiple units. No special foundation or costly stack is needed. As delivered, *Powermasters* are fully equipped, completely wired and factory fire-tested for fast operation as soon as fuel, water, electrical and steam connections are made. Other cost-saving advantages are high fuel economy at all loads, space-saving compactness, dependability, maintenance-saving accessibility, fully automatic operating and safety controls, smokeless combustion and hospital-clean boiler room.

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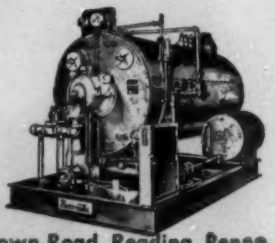

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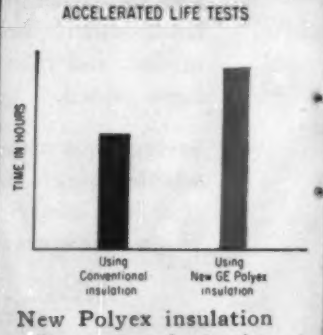

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General Electric has developed a complete new insulation for form-wound coils which lasts 50% longer than any other Class A insulation in use today. Its greater ability to withstand physical and thermal stresses, and resist contaminants, provides an added margin of protection that will mean tremendous savings to you because of reduced motor failures and reduced maintenance costs.

POLYEX INSULATION is a balanced system of polyester films and fibres, together with new hydrocarbon resins. For the first time, materials used are inherent insulators in themselves, and the cotton and paper-based tapes and sheets, used in conventional insulations, have been eliminated.

A FEW OF THE EXHAUSTIVE TESTS on new Polyex insulation are summarized on these pages. Insulation qualities like these offer you tremendous savings in motor maintenance and a greater degree of service continuity than ever before possible.

FOR FURTHER INFORMATION, contact your nearby G-E Sales Representative, or write for Bulletin GED-2460, Section 830-15, General Electric Co., Schenectady 5, New York.

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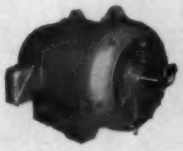

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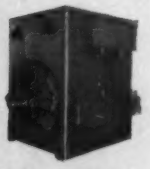

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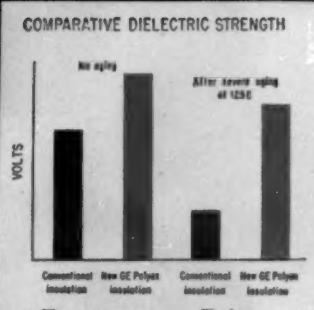

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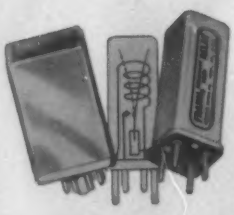

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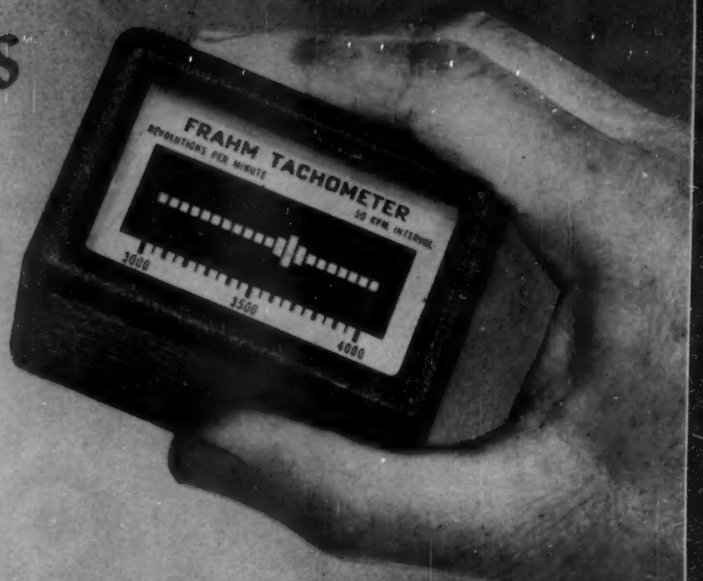

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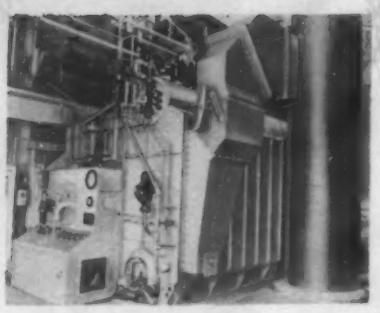
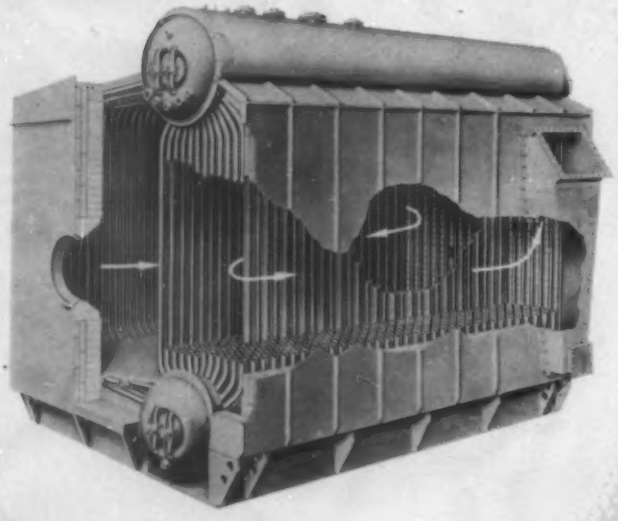


Industrial installation of VP Boiler in the South. Capacity — 33,000 lb steam per hr; design pressure 250 psi.

Cutaway view showing arrangement of two-pass VP Boiler.



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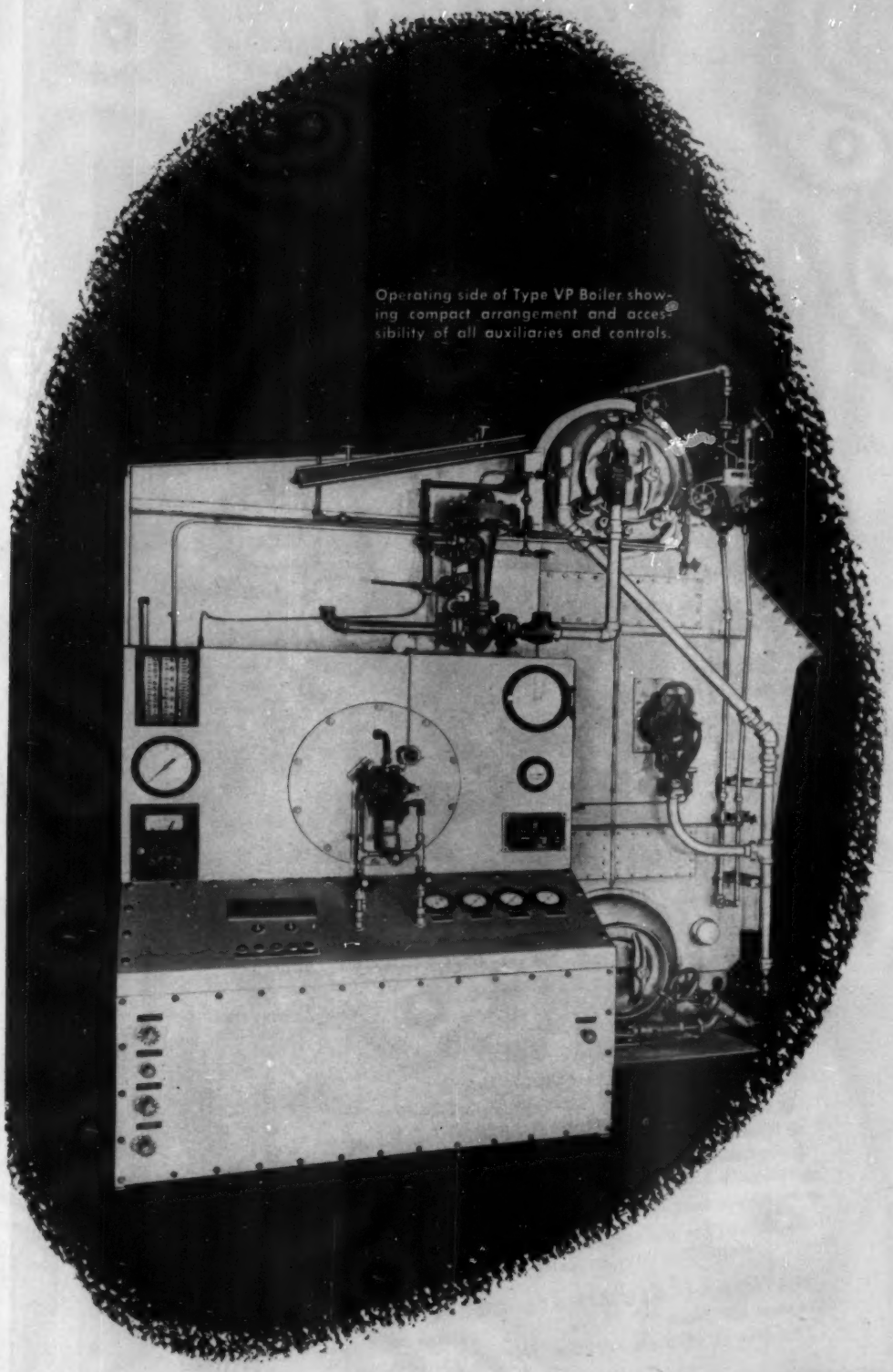

Operating side of Type VP Boiler showing compact arrangement and accessibility of all auxiliaries and controls.

Combustion's well known C-E Package Boiler, Type VP, has a *new look*... outside and inside!

Outside. The VP's exterior is more streamlined, more compact. The controls and fan are now an integral part of the boiler front. Duct work is simplified. This means better appearance, easier maintenance, better operation.

Inside. Now instead of 2" diameter tubes you'll find 2½" tubes swaged down to 2" at the drums — in all sizes above 15,000 lb per hr capacity. This permits closer spacing of the tube surfaces in the main boiler bank and results in up to 25 per cent more heating surface per tube. It increases mass flow rates, assuring more efficient heat transfer. All this adds to up more steam than from the former VP Boilers of the same size.

All of the existing *extra* features which contributed to the enthusiastic acceptance of the original VP design remain. Briefly summarized they are:

- **More water cooling** per unit of furnace volume than any other boiler of the VP's size and type.
- **Quiet centrifugal fan,** which operates at low speed and with an exceptionally low noise level.
- **Large lower drum,** which facilitates handling wide load swings ... permits a simple, symmetrical tube arrangement ... simplifies inspection.
- **Single Burner** assures balanced furnace conditions and air distribution ... is easier to operate and to maintain ... simple burner control equipment ... no air leakage through idle burner ... change oil gun, when required, in seconds.
- **Simple baffle arrangement,** which means maximum heat transfer rate ... no dead gas pockets ... simplified soot blowing.

The *New* VP Boiler not only looks more attractive but it is functionally improved and stands ready to deliver more steam per dollar.

Write, today, for complete information. Ask for new catalog VP-116 (just off the press) which contains specifications and general information on dimensions, space requirements, construction details and controls. B-912

THE VP BOILER is available in capacities ranging from about 4,000 to 40,000 lbs of steam per hr, and pressures up to 500 psi.

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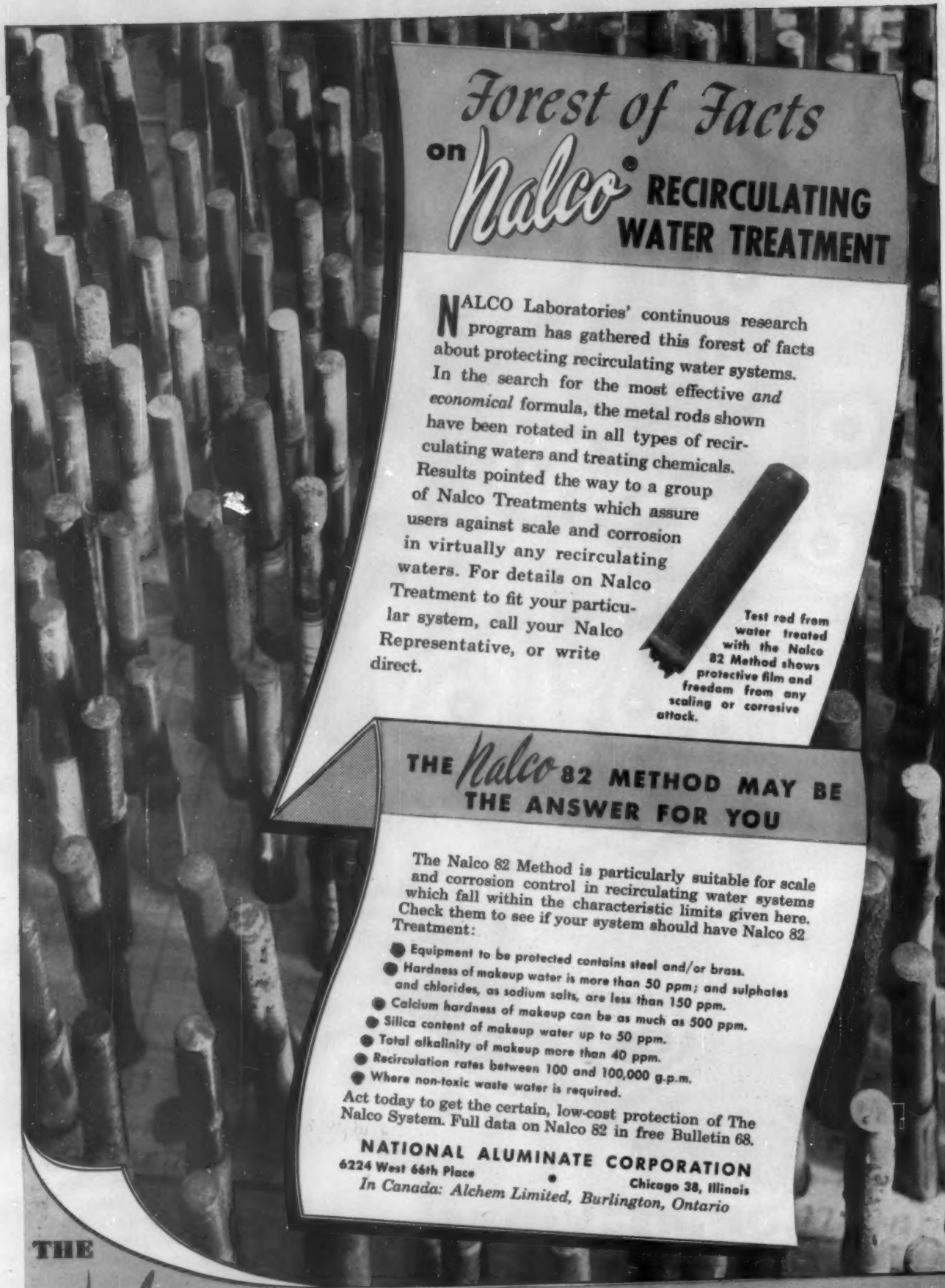

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THE Nalco 82 METHOD MAY BE THE ANSWER FOR YOU

The Nalco 82 Method is particularly suitable for scale and corrosion control in recirculating water systems which fall within the characteristic limits given here. Check them to see if your system should have Nalco 82 Treatment:

- Equipment to be protected contains steel and/or brass.
- Hardness of makeup water is more than 50 ppm; and sulphates and chlorides, as sodium salts, are less than 150 ppm.
- Calcium hardness of makeup can be as much as 500 ppm.
- Silica content of makeup water up to 50 ppm.
- Total alkalinity of makeup more than 40 ppm.
- Recirculation rates between 100 and 100,000 g.p.m.
- Where non-toxic waste water is required.

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BOILERS, GENERATORS

201 **Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

202 **Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

203 **Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

204 **Efficient Little Boiler** — Bulletin AD-135 describes company's CB 50–80 boilers available in 50 to 80 hp (15 to 150 lb steam, 30 lb hot water) for heating and processing. Stresses such advantages as silent operation, fuel flexibility, speed, easy maintenance, and automatic operation. Discusses new hinged front and rear doors, forced draft systems, other features. Includes drawings and specifications. Cleaver-Brooks Co.

205 **Shop Assembled Boilers** — Two-drum, bent tube package units for steam and high pressure and high temperature hot water are the subject of this illustrated bulletin. Gives construction details, dimensions, ratings. Springfield Boiler Co.

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207 **Steam Generators** — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

WATER CONDITIONING

209 **Modern pH and Chlorine Control** — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

210 **What's What on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

211 **Water Conditioning Data Book** — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title. The Permutit Co.

212 **Steam System Treatment** — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

213 **Feedwater Treating** — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

214 **For Industrial Water Softening** — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

215 **Testing Equipment** — Designed for use as a guide in the selection of water testing equipment, this 12-pp bulletin de-

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Astoria Fuel Line

continued from page 73

and guided on top of the oil lines. Thus the oil lines resting on the cellular glass slide along it during temperature changes while the tracers slide on the oil lines. The resultant movement of the vertical lines at the pit was absorbed by the inherent flexibility of the overhead piping.

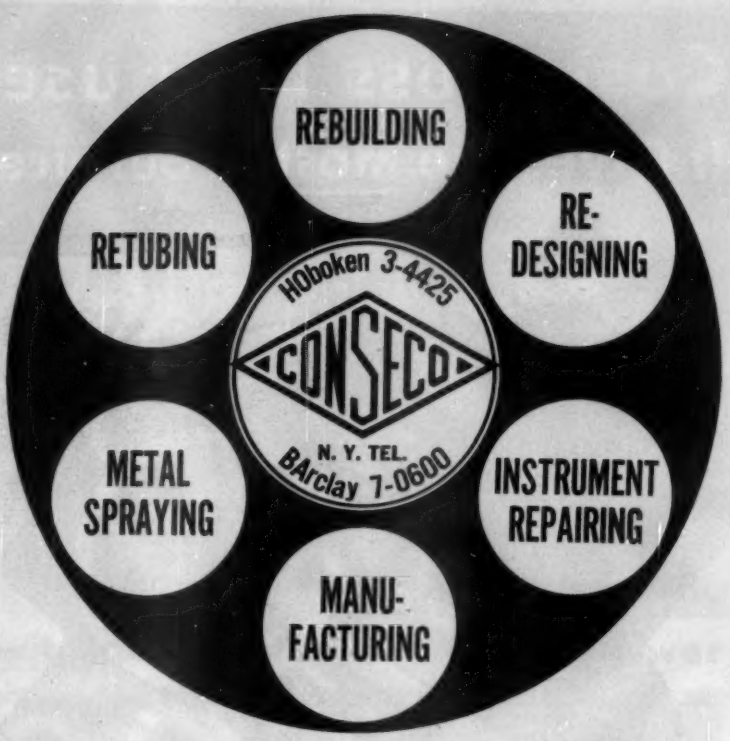
To provide for the transverse movement of the lines at two underground right-angle turns, larger sized insulation was used and chocks were placed between the bottom of each oil line and the insulation to center the pipe thus providing the necessary room for expansion within the insulation. The movement permitted by this arrangement is slight but was adequate.

In laying out steam traced oil lines provision must be made for the expansion of the oil during shut down. Heavy fuel oil increases its volume about 7 per cent when heated from 100 F to 300 F. An oil line in the shutdown state if valved off and the tracer steam left on will burst due to the pressure build-up. Each pipe section of a fuel oil system must be analyzed for this possibility and if it exists some form of relief provided. At the Astoria boiler house where convenient disposal for expanded oil was not available, the successive fuel shut-off valves were equipped with spring loaded check valve by-passes which permit the oil to expand back to the pump house where relief valves are provided.

Steam Supply

Steam at a maximum of 160 psi is supplied to each tracer line at three points. The longest section fed is approximately 2,200 ft long and steam separators and traps were installed at 750 ft intervals to remove the condensate. It is estimated that radiation from each of the overhead oil lines on a zero degree day is about 125 BTU per hr per lineal ft.

The conventional solenoid operated fuel oil shut-off valve with which most oil-fired boilers are equipped when associated with long supply lines may create a serious "water hammer" problem. In the case of our long lines closure of this valve in less than three seconds is the equivalent of instantaneous closure. Where instantaneous closure or its equivalent occurs the theoretical pressure build-up in psi is equivalent to approximately 47 × velocity in ft per sec of the oil flow in the line at the time of interruption. This pressure is added to the static pressure. All pipe line appurtenances, therefore, must be designed for the maximum pressure thus imposed. At Astoria the piping, gages and other oil line equipment was designed to withstand this "water hammer".



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Astoria Fuel Line

continued from page 121

Our experience to date after one year's operation of these oil lines indicates that joints of steam tracer lines should be welded. The overhead portion of the lines were installed with screwed couplings some of which developed leaks which were troublesome to repair. The underground tracers installed have socket welded joints and there have been no leaks in these sections. With the exception of the leaks experienced the tracer system has given satisfactory service.

Handling Fuel Oil

continued from page 85

150 psi are common practice and can be used for general design. Design the pumping oil flow to the burner at least 150 per cent of maximum oil consumption to allow ample oil return.

When the boiler or furnace is of the "package" type or natural draft, and not over 400 hp, the mechanical rotary cup burner is quite satisfactory, particularly since it normally comes integrally equipped with forced draft fan and oil pumps. Since the burner has a pump within the assembly, a transfer pump is not usually necessary; however, the design should be carefully reviewed regarding the suction conditions, which might be excessive. A heavy oil temperature of 180 to 200 F is still recommended.

Controls are the nerve system and a must for any heavy-oil handling system and extensive consideration is recommended. They represent cheap labor and valuable assistance for the operating engineer. Basically, the necessary controls consist of temperature controlled valves on the steam to the suction heater and preheater, temperature controlled relief valve around the pre-heater, pressure relief valves on the pump discharge, and combustion controlled regulating valves on the burners.

Where the system is open, clean, and of higher capacity, pneumatic pilot-operated controls are very satisfactory and allow remote control. Make sure emergency air is available. Self-contained control valves are quite satisfactory where systems are small and relatively inaccessible. Generally, the choice should be based on similar systems already installed throughout the plant. Make sure the controls are protected against freezing.

Instrumentation is nearly as important as control. It provides an ideal source of trouble shooting information. Vacuum gages should be installed on pump suctions. Pressure gages should be installed on the pump discharges, at the burners and on the oil return. Thermometers should be installed on the suction heater and preheater discharge lines.

Integrating meters should be installed on the pump discharge and tank return lines to obtain net oil quantities burned. Tank level indicators should be installed on larger installations and checked with calibrated tank sticking.

In conclusion, it must be stressed that the designer know his system and keep it clean and simple. A boiler plant cannot be any better than its oil handling system. Consider control, accessibility, and maintenance, as the operating engineer must be the final judge of this "art" of engineering. Figure 4 shows a flow diagram of a typical system with controls and instrumentation.

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Water by Bootstrap

continued from page 93

valve around the turbine to the screen tanks. An interconnection between the by-pass and the wicket gates opens the former as the latter closes, thereby maintaining the penstock velocity. Minor variations in gate settings can be made, however, without shunting water to the by-pass unnecessarily and wasting power.

Since the synchronous by-pass is required to furnish rather fine adjustments to maintain water velocity, it is provided with two operating ranges. When both pumps are operating (normal), the by-pass is in the two-pump position; when one pump is off the line, an alarm warns the operator to change the by-pass setting to one-pump operation. Should both pumps shut down, another alarm warns the operator to close the turbine inlet valve to avoid draining the line.

When the hydraulic turbine trips out, all their power must come from the steam plant. When this happens, a large block of power required by their wood-room is automatically disconnected and this capacity transferred to the pumps. *next page*

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Water by Bootstrap

continued from page 123

Details for the control and operation of this unique "bootstrap" water system are given in the accompanying table and are illustrated in Fig. 2.

OBITUARIES

Edwin R. Little

EDWIN R. LITTLE, president and treasurer of the E. R. Little Co. of Detroit, died last November at his home, as a result of a heart attack. He was 67 years old.

Mr. Little was born in 1887 in Norwalk, Ohio, attended Denison University, and was graduated at the University of Michigan in 1913 with a degree in mechanical engineering.

Edwin R. Little

He then spent 1½ years with the Corps of Engineers, United States Army, on design and construction of locks at Sault Ste. Marie, Mich.; a year as construction engineer for the Edison Sault Electric Co., and a year as design engineer for Consolidated Engineering Co. of Chicago.

In 1916 he began his consulting practice, and since 1919 had been president and treasurer of his company. In that capacity he supervised details of design and construction on many power plants and industrial developments. He designed and built installations for the City of Detroit, including the Mullett Street Heating Plant, power houses for such important companies as Michigan Paper Co. and Detroit Sulphite Pulp & Paper Co., Continental Aviation & Engineering Corporation and others. For the State of Michigan, he designed power plants, numerous buildings, distribution systems and engineering services for state hospitals such as those at Eloise, Newberry, Northville, Caro and many others. A very interesting power plant he designed for the Ionia Reformatory was described some time ago in POWER ENGINEERING.

Mr. Little wrote many fine technical

articles for POWER ENGINEERING and other technical publications. He was a member of ASME, Engineering Society of Detroit, Detroit Athletic Club and Sigma Chi Fraternity.

NEW ENGINEERING BOOKS

Handbook of Industrial Safety Standards. Revised and Expanded Ninth Edition; 315 pages, 82 illustrations, 27 tables; paper bound; 5¼ by 8 in. Prepared and published by Accident Prevention Department of the Association of Casualty and Surety Companies, 60 John St., New York 38, N. Y. Price $1.40.

This handbook is a valuable compilation of industrial safety requirements recommended by such nationally recognized authorities as the American Standards Association, the American Society of Mechanical Engineers, the National Fire Protection Association and various governmental organizations. Whenever possible the material has been drawn from codes and recommendations that have been formulated by men familiar with both the practical and technical aspects of the subjects.

Only the more important items in the field of industrial safety are covered. Included as an appendix, however, is a list of pertinent safety codes with information as to how they may be obtained. As a further guide, at the end of each of most sections, there is a reference list naming the safety codes which are especially applicable to the subject matter of that section. The book is an excellent reference for plant administrators, safety directors and engineers.

★ ★ ★

Machinery's Handbook. Size 4¾ by 7¼ in.; 1911 pp; 15th edition; illustrated; cloth bound. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $9.00.

Additions and changes to this new edition of the widely popular publication make it even more valuable than before. Along with its tabulated information, the book contains quite a bit of text material pertaining to machining operations and engineering.

The familiar notched page arrangement of the predecessors is retained and makes it easy to open the handbook to a section of specific interest. This is supplemented by an extensive index which gives a fine breakdown of the contents.

New material appears on generaled bevel gears, fine pitch worms and wormgears, and ball, roller and needle bearings. The milling cutter portion, in this edition, includes tables on tolerances and dimensions of different American Standard milling tools.

Among the 13 main divisions of the handbook are the following: limits, gages; small tools; speeds, feeds; steel alloys; motors; weights and measures.

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CATALOG LIBRARY

continued from page 120

scribes complete line of titration stands and test sets for hardness, alkalinity, chloride, sulfide, etc.; cabinets and test sets for similar tests; Conducto bridge for determination of specific conductance of water solutions. W. H. & L. D. Betz.

216 Demineralizers — Valuable information on demineralization is offered power engineers in comprehensive 24-pp Bulletin WC-111. Discusses demineralization in general and its advantages and applications. Basic types of demineralizers and their special uses are charted. Resins, piping, valves and accessory equipment are treated in detail. Book also provides flow charts showing demineralization systems for chemical plants and power plants. Graver Water Conditioning Co.

217 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

218 Chemical Control and Testing — The need for intelligent chemical control and testing to assure the success of a water conditioning program is described in this 6-pp pocket-sized folder. Emphasizes need for explicit control limits and chemical tests to show that these limits are being met, and proper technical skill required to prescribe these limits. Also shows varying needs for testing equipment by different types and sizes of plants. Hall Laboratories, Inc.

COAL, ASH HANDLING

219 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

221 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

223 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

224 Pneumatic Handling System — Of value to power engineers concerned with the handling of dry pulverized materials, 16-pp Bulletin G-2 tells how handling costs can be reduced by using the proper pneumatic handling system. Lists 86 dry pulverized materials and indicates which of three systems is best suited to handle each

material. Discusses company's system for conveying such materials as Portland cement, pulverized coal. Fuller Co.

225 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

226 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

MATERIALS HANDLING

228 Conveyor Belt Chart — Engineering data for standard conveyor belt constructions is given in this chart and accompanying sheet. Strength characteristics of eight popular ply and material combinations of conveyor belt constructions are provided. Each property is printed on the chart in a different color to facilitate comparison. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

229 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

TUBING AND ACCESSORIES

231 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Gives details on proper installation. Scovill Mfg. Co.

232 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

234 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

235 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

236 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the

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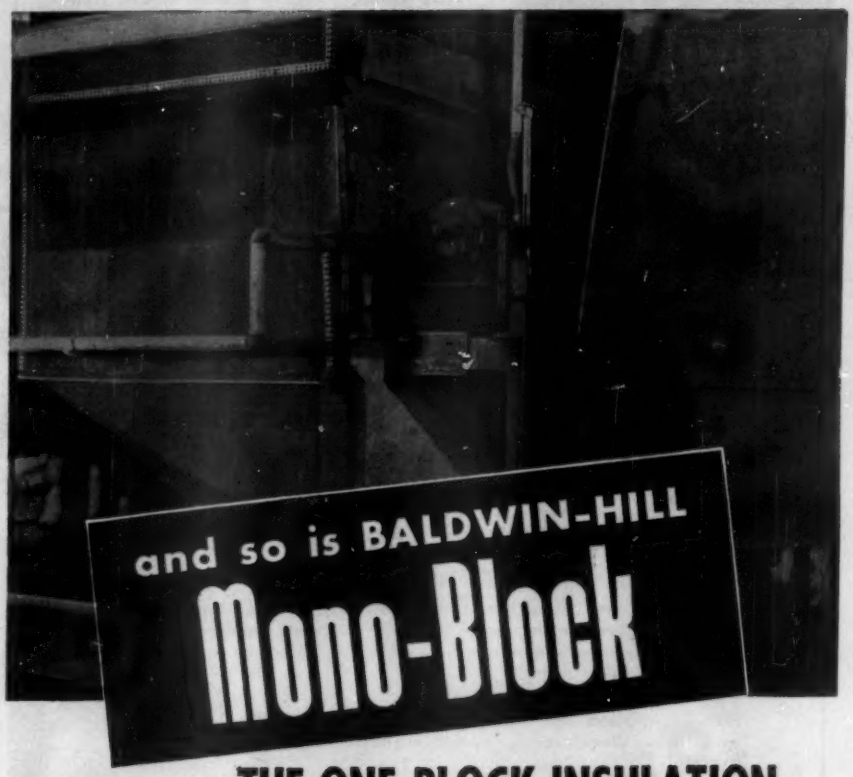

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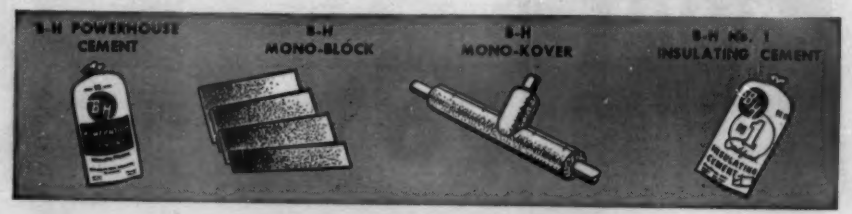

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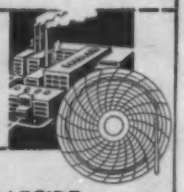

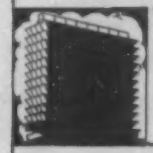

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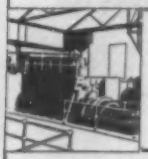

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causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

PUMPS, PUMPING

237 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

238 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

240 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data included. Pacific Pumps, Inc.

241 Vertical Pumps — Bulletin B-1700, 11-pp, presents four features which distinguish close coupled vertical pumps and suggest their use in transfer of process liquids and water — flexibility of construction; adaptability to pumping system's present available NPSH; space saving design; and availability in both transfer-type and process-type construction. Includes many diagrams. Peerless Pump Div., Food Machinery and Chemical Corp.

FUEL OILS, LUBRICANTS

242 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. A chart shows relation of engine performance to fuel properties. Sinclair Refining Co.

243 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

244 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

245 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp arti-

cle on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The special requirements of porous bearings are also discussed. The Texas Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

247 **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes The Chapman Valve Mfg. Co.

248 **Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

249 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

250 **Blow-Off Valves** — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

251 **For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

252 **Regulating Valves** — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

253 **Valve Chart** — Form 194, 24-pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

254 **Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. Crane Co.

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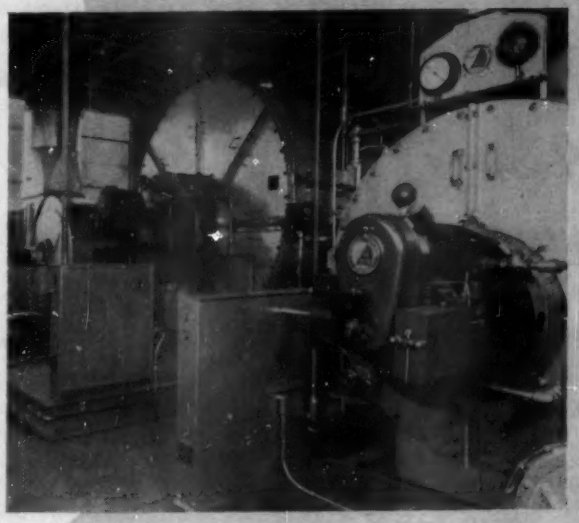

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255 **Steel Gate Valves** — Five types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 B, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

256 **General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

257 **Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

258 **Steam Trap Solutions** — Bulletin F.151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives pointers on installing and servicing traps. The V. D. Anderson Co.

259 **Industrial Steam Traps** — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications. W. H. Nicholson & Co.

261 **Unions and Fittings** — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

262 **Forged Fittings** — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

263 **Welded Fittings** — Catalog 3 is a 36-pp ordering and engineering reference book on company's Weldolets for piping services. Gives data on butt-welding and socket welding Weldolets as well as on Thredolets for making threaded outlets. Typical installations are pictured; sizes, weights and prices provided. Also included are installation instructions and a technical section. Bonney Forge & Tool Works.

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ELECTRICAL EQUIPMENT

265 **Motor-Generator Reference Book** — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg Co.

266 **Batteries for Control, Switchgear** — This company's PlastiCal (lead calcium) and PlastiCell (high-tensile alloy grid batteries for control, switchgear, and auxiliary power are described as to design, application and performance in Bulletins CP-536 and CP-537. Specifications and dimensions included. C & D Batteries, Inc.

267 **The Answers on Wiring** — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

269 **Insulation Temperature-Resistance** — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, and a practical method of obtaining insulation temperature. James G. Biddle Co.

270 **High-Capacity Fuses** — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of

600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

INSTRUMENTS AND CONTROLS

271 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

272 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feed water automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.

274 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

275 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

277 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are given, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

278 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

279 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

INSULATION

280 Pipe Insulation — Mono-Kover, a lightweight one-piece pipe insulation, is described in this bulletin. Photos show how easily it is applied, and text covers its thermal resistance, permanence, resiliency, non-corrosive properties and

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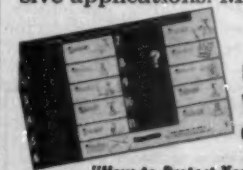

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lower applied cost. Also included are a thermal efficiency chart, insulation thickness selection table, and information on sizes and thicknesses available. Baldwin-Hill Co.

281 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

OTHER EQUIPMENT

282 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for condensers. Henry Vogt Machine Co.

283 Turbine Speed Control — Thirty-pp wire-wound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

284 Rupture Discs — Catalog 77-30, 6 pp, fully illustrated, gives construction features of a rupture disc for low pressure and highly corrosive applications, sizes 2 through 10 in., and rupture pressures from 5 to 100 psig. Discusses operation, pressure ranges, manufacturing tolerance, choice of materials. Black, Sivalls & Bryson, Inc.

285 Steam Accumulator — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

286 Steam Air Ejectors — This 12-pp newly-revised booklet describes steam jet air ejectors for efficient, low cost air removal from condensers. Well illustrated with photos and drawings, it explains ejectors' principle of operation and their classification according to stages and elements. Discusses inter-after condensers, steam jets for special services, air ejector accessories. An engineering data section

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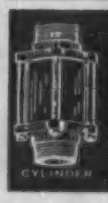

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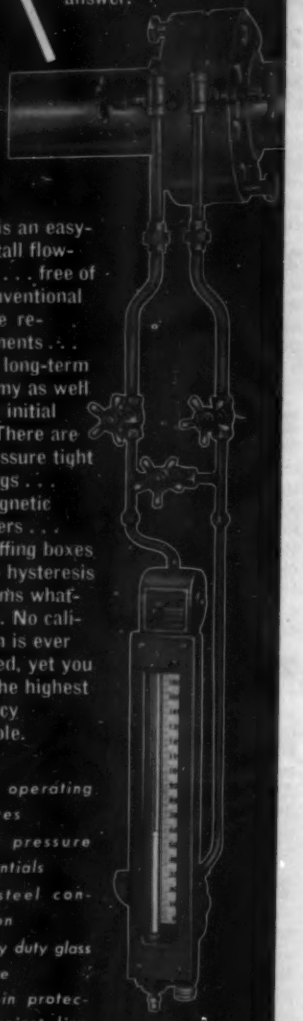

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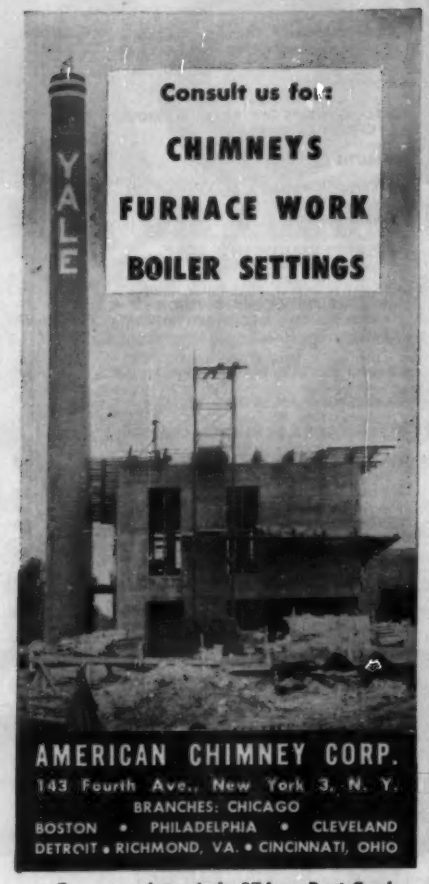

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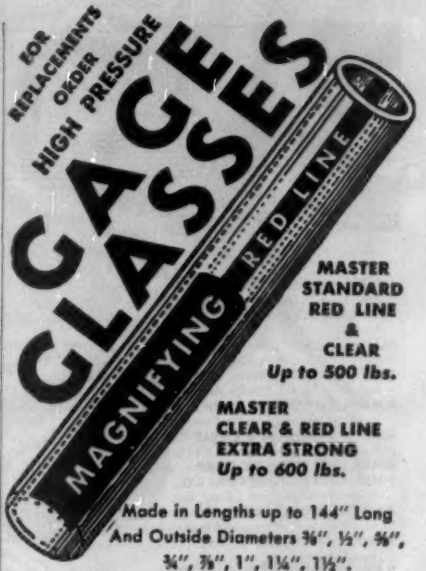
covers method of determining requirements for power and process plants. Condenser Service and Engineering Co., Inc.

287 Chemical Cleaning — Technical information on how preventive maintenance cuts replacement costs is contained in this pamphlet which describes how dirty and clogged filter beds were restored to operating efficiency through chemical cleaning. Describes company's preventive maintenance program. Dowell Inc.

288 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. L. J. Wing Mfg. Co.

289 Good Operating Practices — Some 101 good suggestions for maintaining plant buildings and equipment are presented in the 12-pp new edition of this booklet. Well illustrated, contains latest recommendations for getting the best service out of insulations, packings, refractory products, roofings and friction materials. Johns-Manville.

290 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Also gives detailed information on accelerators, thinners, primers. Goodall Rubber Co.



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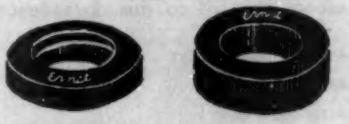

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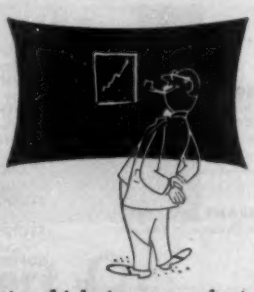

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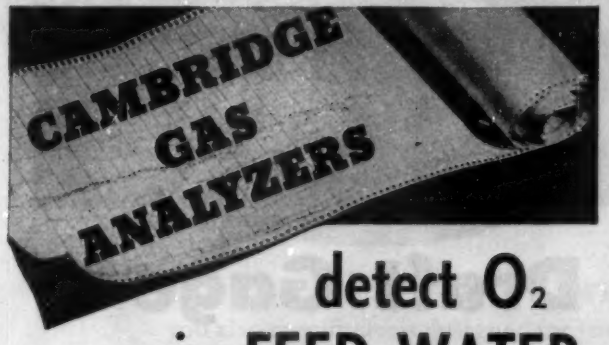

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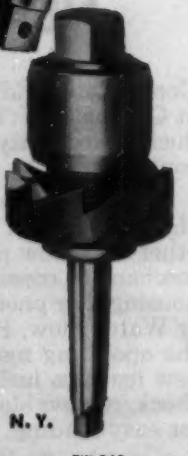

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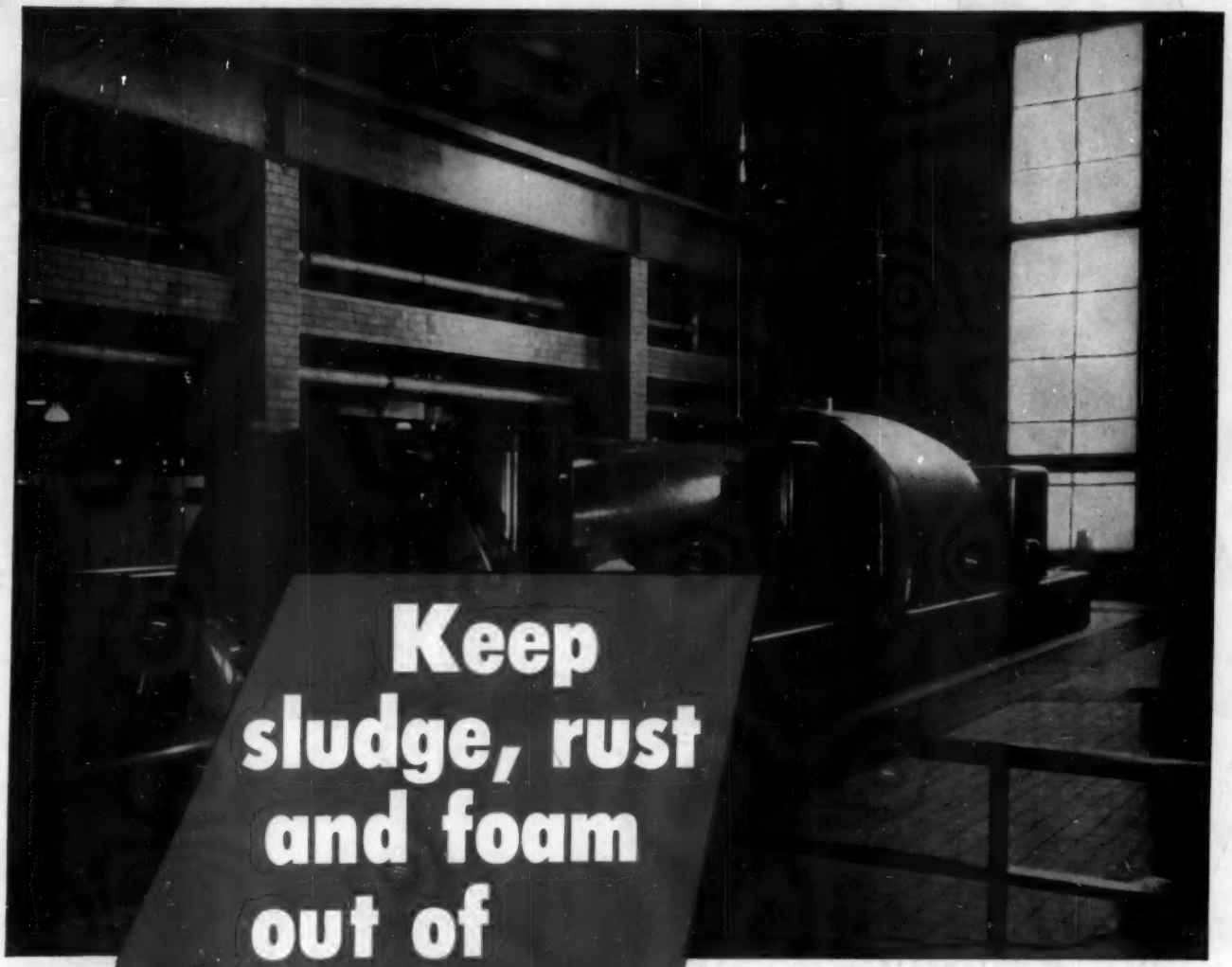

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